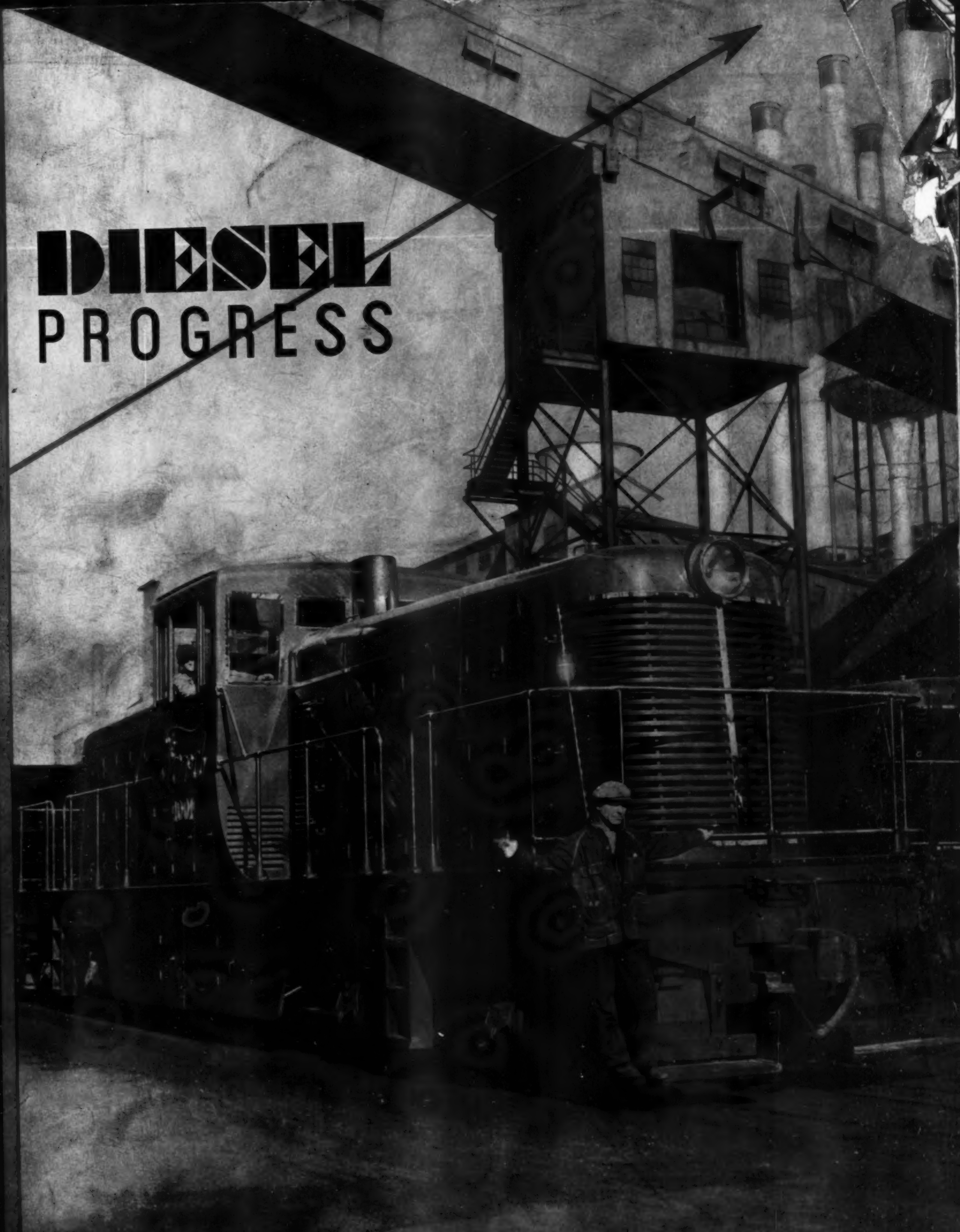
# DIESEL PROGRESS

IN INDUSTRY • IN TRANSPORTATION • ON THE SEA • IN THE AIR



DECEMBER, 1937 CIRCULATION OF THIS ISSUE—IN EXCESS OF 11,000 COPIES 25c

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*We are glad to announce the placing in service of the first*

# ALCO-SULZER DIESEL ENGINES

Between April, 1926, and the same month in 1936, we have had no technical relations with any Diesel engine concern in the United States, and thus for the first time modern Sulzer designs developed since 1926, incorporating new features, are being applied to Diesel engines built in America.

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*Sentinel Oil Filter Model No. 400 as installed on the three new General Sea Foods trawlers.*

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SPECIFICATIONS for the three new General Sea Foods trawlers demanded the highest quality and performance in every respect. It is not surprising, therefore, to find SENTINAL fuel oil filters on each of the 650 hp. Cooper-Bessemer propulsion Diesels. Dependability means extra profits for owners and crew—it may mean the difference between life and death at sea.

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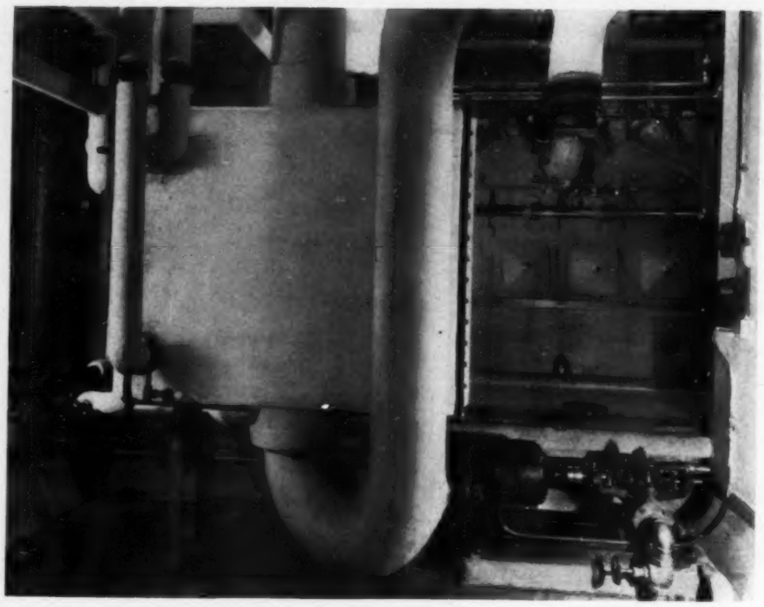
Since June, 1935, a waste heat water heater in the Singer Building, New York City, has returned 300,000 B.t.u. per hour to boiler feed water. By November, 1936—seventeen months after installation—this water heater had repaid its cost and has been earning a profit of from eight to ten cents per hour since that time.



*Waste heat water heater of the extended surface, cast iron, armored element construction, operating in conjunction with a 550 horsepower Winton Diesel engine in the power plant of the Singer Building, New York City.*

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Waste heat from the exhaust gases of a 550 horsepower Winton Diesel engine are cooled from 625 deg. F. to 180 deg. F. in passing through the water heater and this heat is transferred to boiler feed water, reducing fuel consumption. No supervision of the water heater is required and no money has been spent on the heater since its installation except for external paint. The annual saving is taken at 70 per cent of the cost of the water heater installation.

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| 100 | 60 | 118,000 | 78,000 | 38,000 |
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| 200 | 120 | 212,000 | 140,000 | 68,100 |
| 300 | 180 | 318,000 | 210,000 | 102,500 |
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To obtain pounds of water per hour divide B.T.U. per Hour by 100.

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ON every size and type of diesel in every kind of service, the BRIGGS CLARIFIER is making record savings in oil and maintenance costs.

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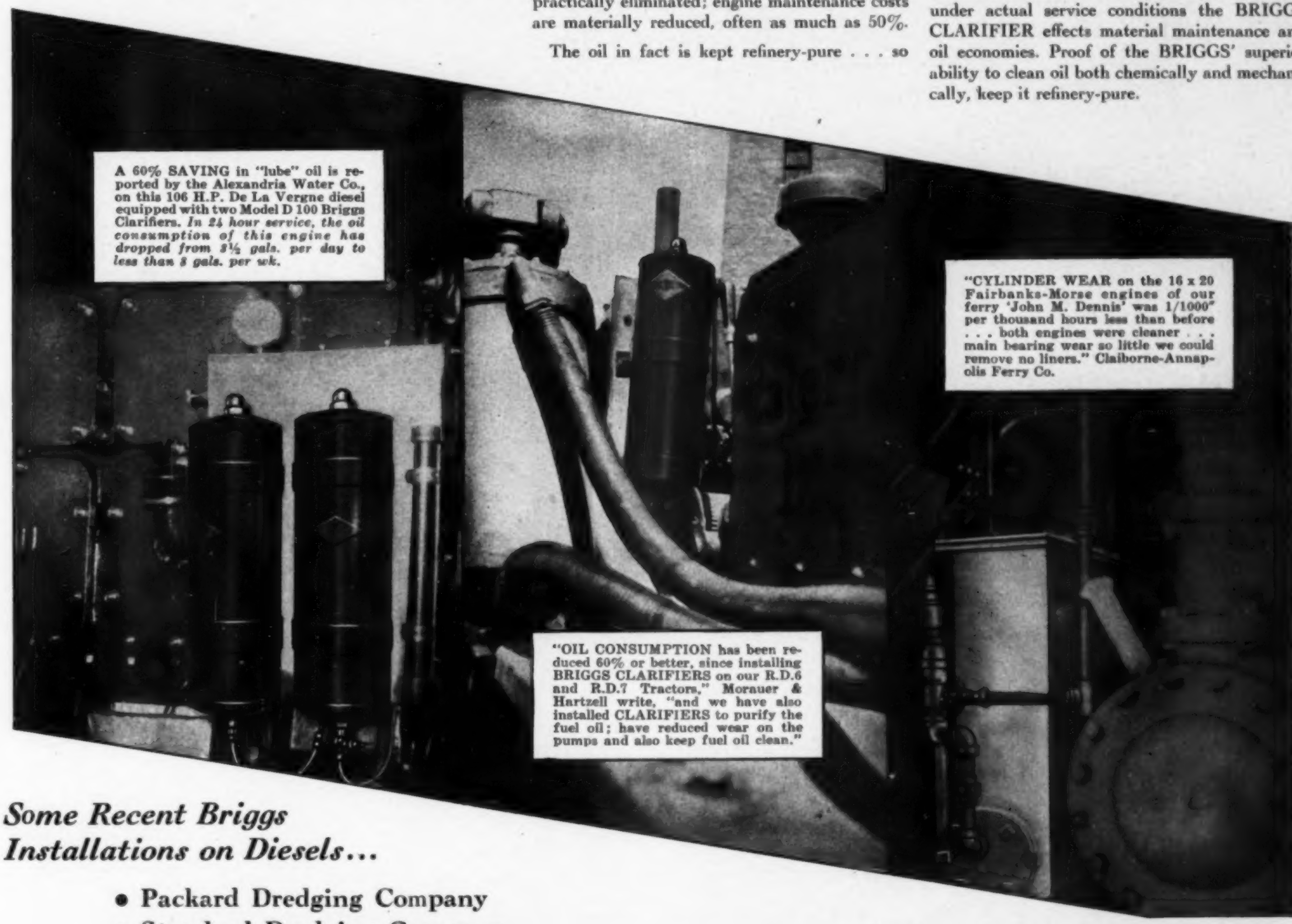


***Some Recent Briggs Installations on Diesels...***

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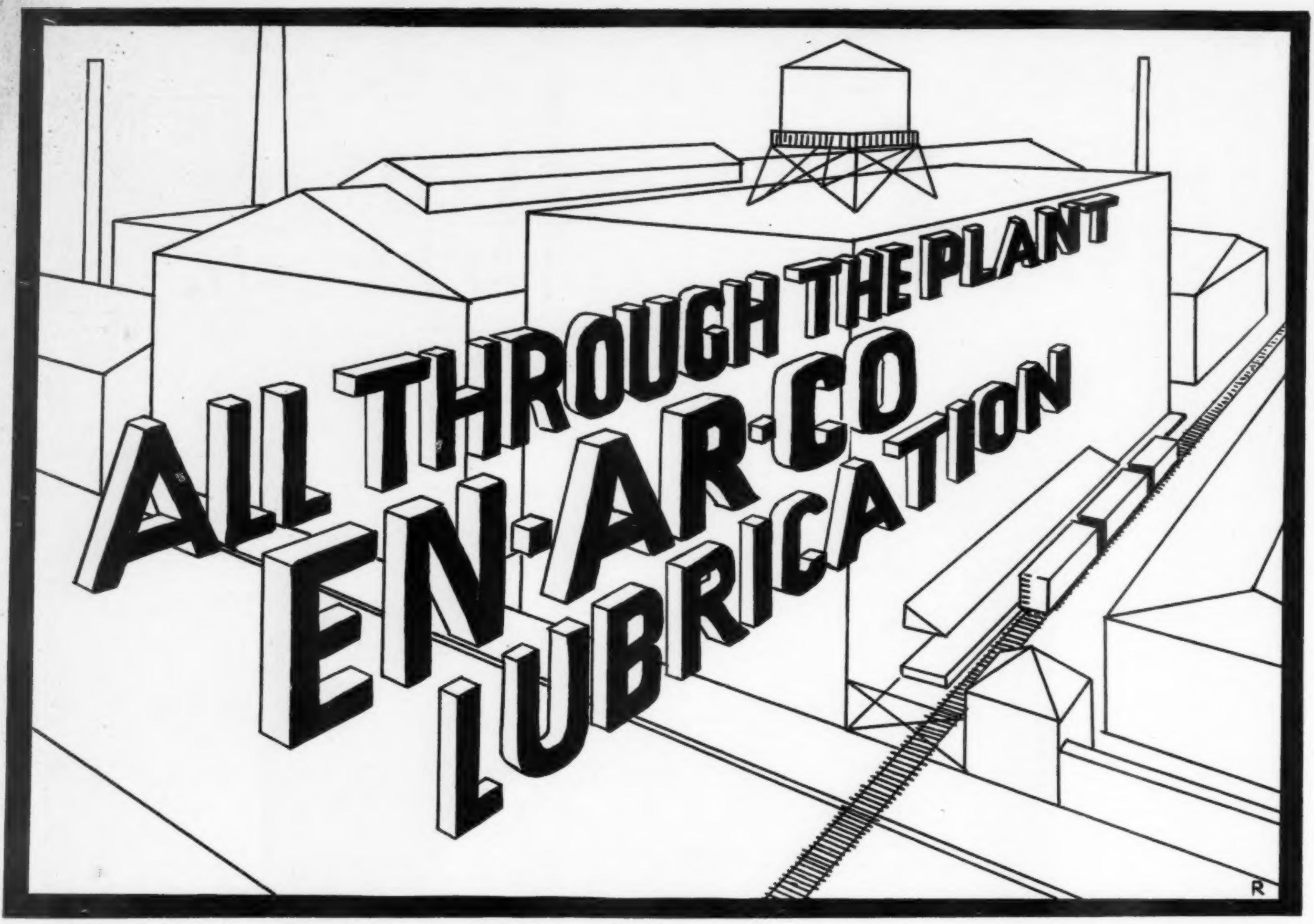



*At the Sign of the Boy and Slate*

There's a specialized, time proved En-ar-co Lubricant for every purpose all through the plant . . . from the largest and most powerful Diesel where En-ar-co Diesel Oils demonstrate real operating economy to the electric motor on the office fan!

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## GIVES YOU BETTER LUBRICATION . .

# Immediately

because RING-FREE is triple-distilled by a patented process that produces each S. A. E. grade without blending, compounding or adulteration in any form. Thus every drop of RING-FREE is a pure petroleum lubricant with all the fine natural characteristics unharmed. That is why it gives you the following improvements in lubrication IMMEDIATELY.

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**IMMEDIATELY** the natural carbon removal qualities of RING-FREE will start cleaning away carbon deposits in the motor. As this cleaning progresses it also improves performance, relieving stuck piston rings and sticky valves.

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2. HIGHER HEAT RESISTANCE
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Nugent Fuel Oil Filters Have 300 Sq. In. Filtering Surface.


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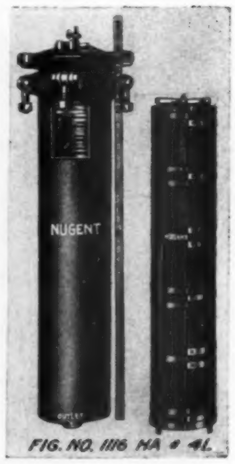


Nugent Lube Oil Filters Have From 300 to 15496 Sq. In. of Filtering Surface.

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**This patented feature appeals to the locomotive and marine designing engineers for it enables them to install a filter having an enormous filtering capacity, in a very small space.**

**The oil is the only thing that moves in a Nugent Filter and it does not wear out, but improves.**

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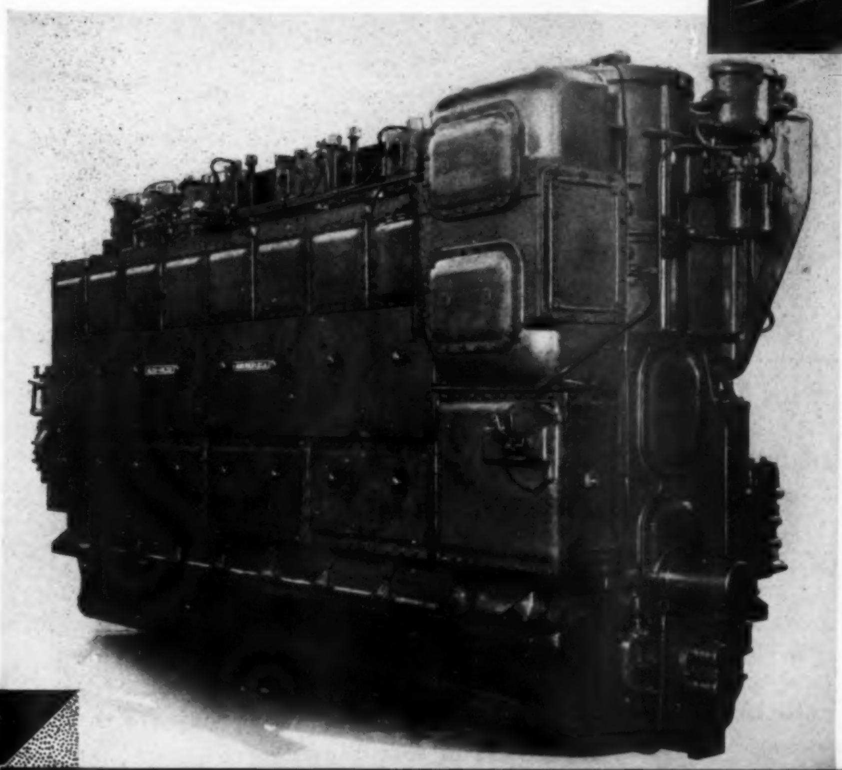

# ALCO-SULZER

## TWO CYCLE DIESEL ENGINE

## COMPACT, NEAT, and SIMPLE

**Photos of two of the most vital parts show complete lack of complexity in the heart of the engine.**

**Alco-Sulzer modern design means high efficiency, smooth running, and big output within limited space.**

*Diesel*

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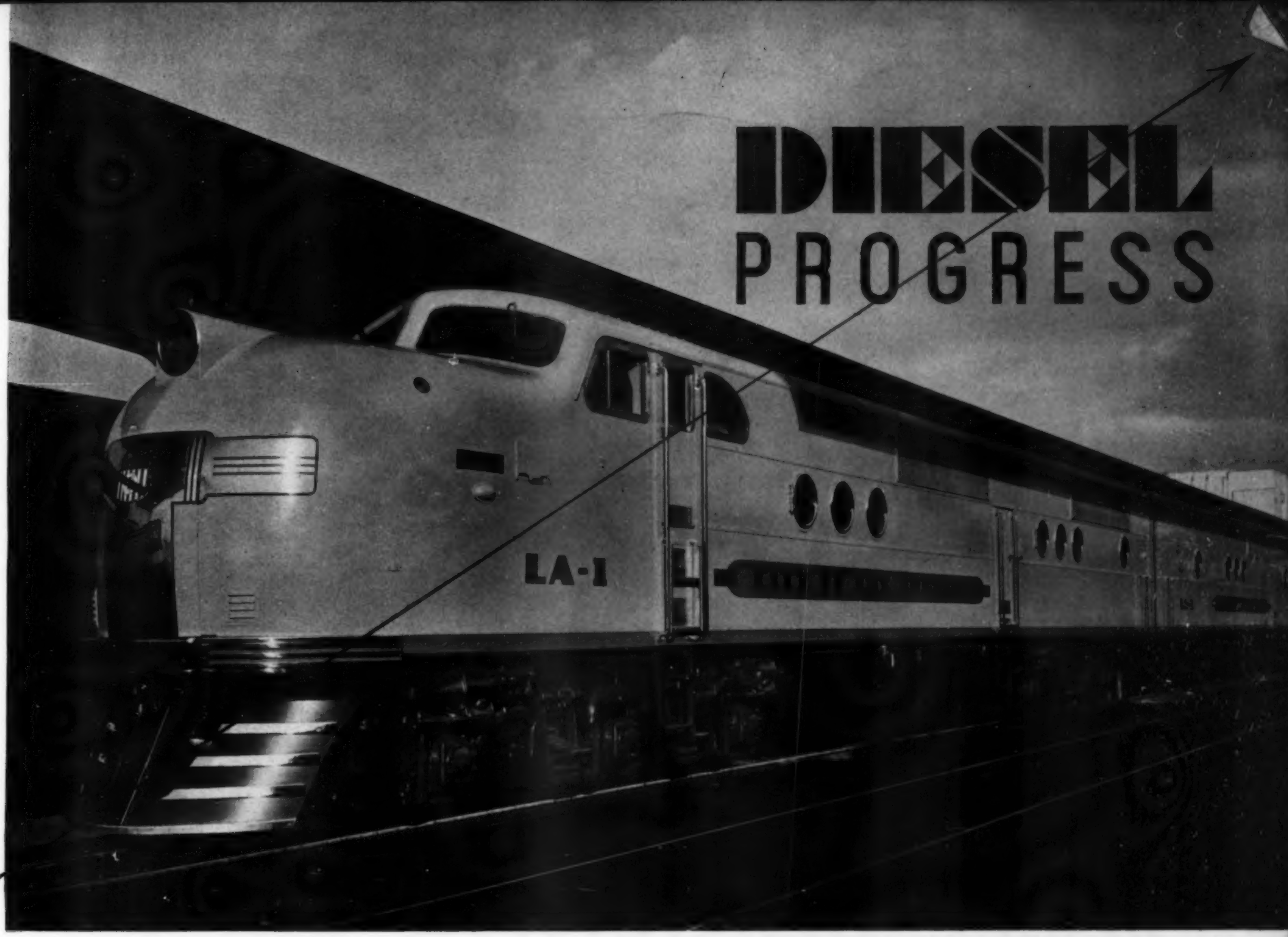


# DECEMBER • CONTENTS

**REX W. WADMAN**
***Editor and Publisher***

FRONT COVER ILLUSTRATION—The new 1,000 hp. Diesel switching locomotive at work in the River Rouge plant of the Ford Motor Company. The twin unit appears in the background. Both locomotives were constructed by the General Electric Company and each carries two 500 hp. Cooper-Bessemer Diesel Engines.

TABLE OF CONTENTS ILLUSTRATION—The newest and largest Diesel streamliner, *City of Los Angeles*, recently delivered to the Union Pacific Lines by the Electro-Motive Corporation. Winton Diesels totaling 5,400 hp. are installed (see page 41).

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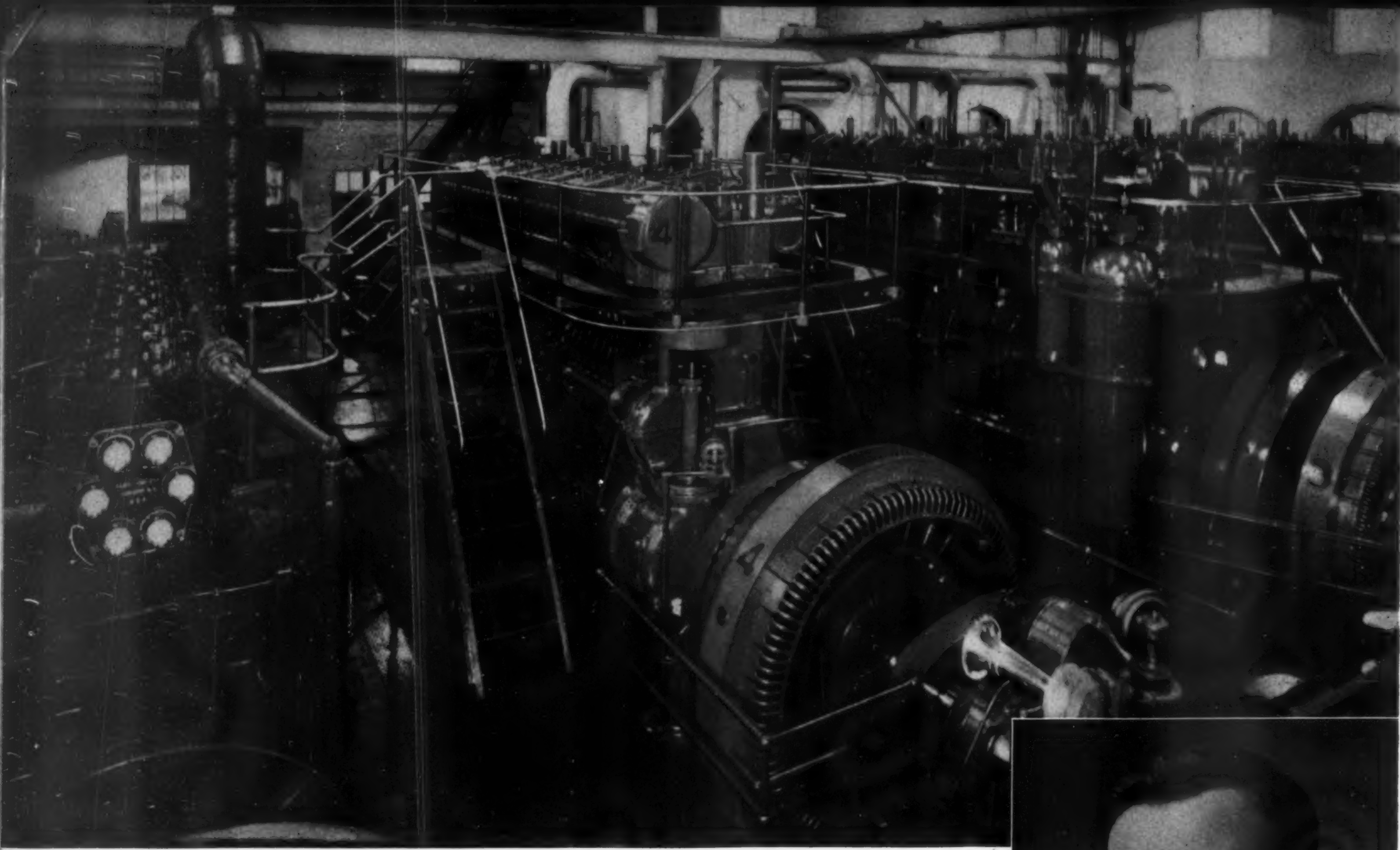


*General view of the engine room after installation of the new 1000 kw. Alco-Sulzer Diesel. This brings the total number of generating units to five with a total capacity of 3525 kilowatts.*

*George D. Noiles, Chief Engineer of the Hudson Municipal Electric Light and Power Plant.*

# HUDSON, MASSACHUSETTS

*By* JOHN W. ANDERSON

"DEDICATED to Service." That is the inscription over the entrance to the municipal power station at Hudson. Not that such a motto is unusual for a public utility power plant, but the prominence of its display here indicates to the world that the management is fully alive to its responsibilities.

The Town of Hudson is situated about thirty miles west of Boston, a typical manufacturing town of about 8,500 population. However, the plant serves the neighboring town of Stow also, so that the total population served with electric power by this station is about 10,000. Lighting customers number about 3,000, and power customers about 200.

While there is a considerable domestic lighting and street lighting load, the main load on the station is a power load coming from the manufacturing interests in the town. These industries include leather footwear, rubber footwear, high grade machines, machine tools, and woolens. All told there is a connected motor load of about 5,000 horsepower. The character of this load is well shown in the graph of the daily load curve; and the rapid increase in residential, power, and total kilowatt hours generated yearly as the power rates were reduced is shown in the other set of curves. The present output of the station is over eight million kilowatt hours per year.

But in order to really understand the background for all of this, it is necessary to go back into a bit of history. It was in 1897 that the town acquired its municipal power plant. The privately owned steam plant and local distribution service were purchased, and the boilers and engines were moved from the basement of a local shoe factory to a new station building on the site of the present plant. The new station was started in 1898.

The station grew in size as the years went by, and in 1918 it became necessary to add a 1,000 kw. steam turbine, which increased the total capacity of the plant to 2,200 kw. At the same time a connection was made with an outside transmission company line, and the station operated in parallel with the transmission line until 1928. But by 1926, the age and condition of the boilers and engines made it imperative that consideration be given to the power plant and the future policy of power generation.

Four schemes were carefully investigated—all outside purchased power, a new high pressure steam station, a combination of these two, and a Diesel engine station. After eighteen months' study, it was decided to build a Diesel station because the best outside power company

rate obtainable was 1.25 cents. It was figured that the Diesel plant could generate current at nine mills. The correctness of the estimates and the wisdom of the decision in favor of Diesel engines have been amply demonstrated by the results obtained.

In April 1928, a contract was signed for the first three Diesel engines. During the station alterations, the power requirements were taken care of entirely by the outside transmission line. It was fortunate that this connection was available at the time because in addition to the installation of the new machinery, major alterations were made in the station building. Half of the engine room roof was raised eleven feet to allow for the installation of a ten ton traveling crane and for plenty of head room over the new Diesel engines. The new Diesel engines were started on January 1, 1929; and on July 1st of that same year, all connection with the transmission line was severed and the station has been on its own ever since.

With this history in mind, the curves showing the kilowatt hours generated take on new significance. Even with the old plant, it is interesting to see how the management was able to reduce the average lighting rate down to eight cents. But observe how the rate began to drop again within less than a year after the Diesel engines started, with another drop of two cents a year later. The management believes that today they have as low an average rate as there is in New England. The steepness of the rise in the curves for kilowatt hours generated is now explained.

The photographs showing the outside views of the old and new station buildings give some idea of the transformation that has taken place. The present building has grown out of the old one, and the modernizing of the machinery within has kept pace with the improvements made on the outside.

The view of the interior of the engine room shows the five Diesel engines and their generators alongside of each other in an engine room 80 feet long by 50 feet wide and a clear height of 25 feet to the roof. There is additional floor space in an ell at one end of the room.

Three McIntosh and Seymour Diesels were installed originally. Two of them were eight cylinder, 17" by 24", four cycle, air injection engines rated at 900 hp. each and direct connected to 615 kw. alternators. The third engine was a six cylinder machine of the same cylinder size and type, and rated at 675 hp. connected to a 460 kw. alternator. Thus the total installed capacity of the original Diesel installation was 1690 kw.

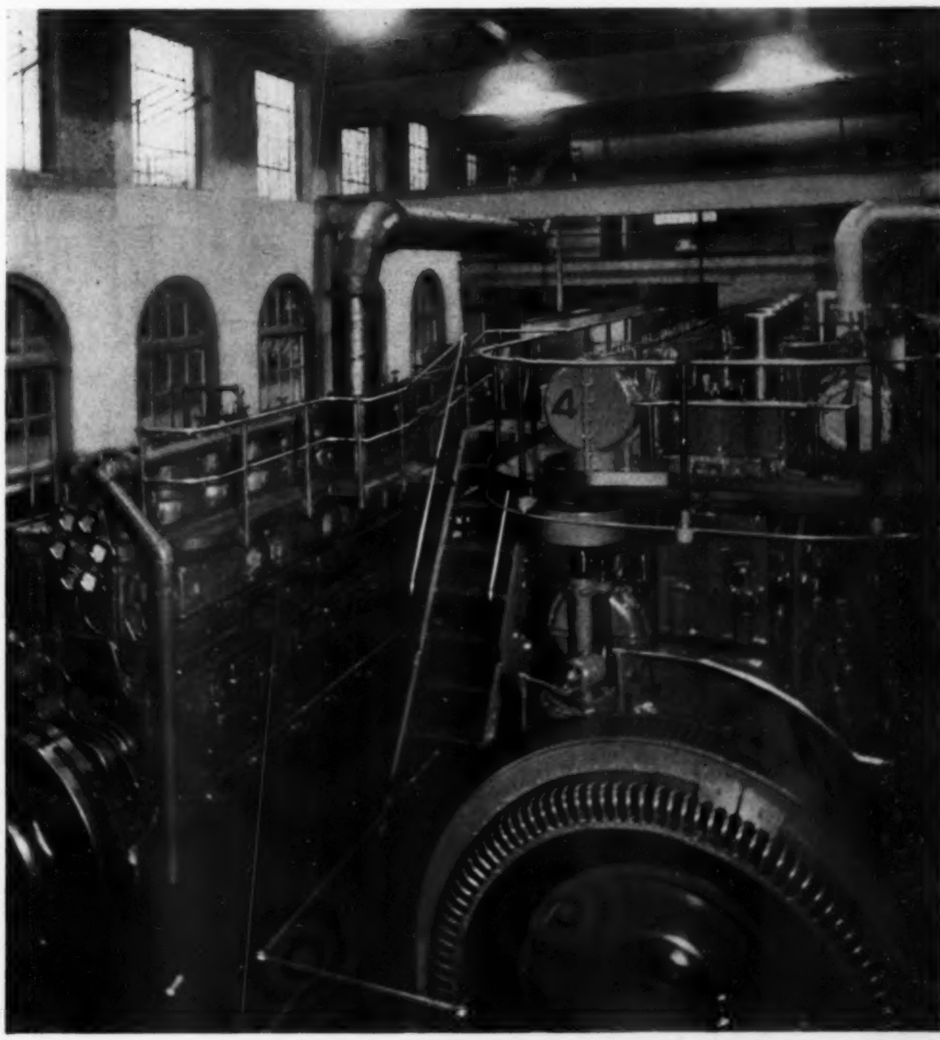
Three years later, a fourth McIntosh and Seymour Diesel was ordered. This engine was placed in operation in February 1933. It is a six cylinder 20" by 24", four cycle mechanical injection unit rated at 1200 hp. and is direct connected to an 835 kw. generator. This increased the total station capacity by 50 per cent.

Now there is just being placed in service the latest engine, an Alco-Sulzer two cycle, eight cylinder, mechanical injection unit with cylinders 14" by 23½" and rated at 1,480 hp. at 277 rpm. It is direct connected to a 1,000 kw. generator. This brings the total rated station capacity to 3525 kw.

However, the firm capacity of the station (with the largest unit shut down) is only 2525 kw., and this is only a comfortable margin above the present peak daily load of about 2300 kw. The daily load curves shown in the plot represents the conditions of two and five years ago. At present, 33,000 kwhs. are being generated daily. The number and range of generator units available permits a very close adjustment of generating capacity to station load. Consequently, a load factor of between 76 and 80 per cent is obtained on the basis of a year's figures. This greatly helps the station economy.

The photographs showing the engine units bring out one striking fact very clearly, namely the progress made in Diesel engine design. Compare the general size and appearance of the several units. The latest engines are in the foreground, and the reduction in overall size in spite of the increase in power developed per unit is evident at once. In fact the latest addition is appreciably shorter in heighth than its predecessors even though it has substantially the same length of stroke. This one point serves to emphasize some of the features of the Alco-Sulzer engine.

This is the first stationary installation of its kind in the country, just as the new Moran tugs already described in the November issue



of DIESEL PROGRESS are the first marine installations with this type of engine in this country. The new engine at Hudson is almost an exact duplicate of the Moran tug engines. The only differences are the very slight ones made necessary by the difference in character of installation.

While these Alco-Sulzer engines are of an entirely new type in this country, they belong to a family of old standing and their development can be traced back to the Swiss Sulzer two-cycle engine. The type we are describing here was put into normal production in Europe in 1932, and many engines have been installed in stationary power plants and in marine applications in different parts of the world. Thus they can be considered as thoroughly proven, and not in any way untried or experimental machines. No detailed description of the engine will be attempted here, because this has already been done in DIESEL PROGRESS for November. However, there are some features of the Hudson engine and the installation worth mentioning.

Foremost is the Sulzer system of scavenging. This has been so perfected that a thorough clearing of the cylinders of exhaust gases and a full charging with fresh air is obtained. This is accomplished by the double row of scavenging ports, which are controlled by valves, and by the special shaping of the ports. As these ports are uncovered, the incoming air sweeps upward on the near side of the cylinder, is turned by the cylinder head, and sweeps downward and out the exhaust ports. After the exhaust ports are closed by the piston at the beginning of the compression stroke, the scavenging air continues to flow into the cylinder through the upper ports and completes the charging process. Even though the scavenging air pressure is only about 4.5 lbs. per sq. in. gage, this is sufficient to give the cylinder a full charge.

Consequently, these engines develop a mean effective pressure rating similar to that obtained in four cycle engines. Combine this with the two cycle effect and the speed at which these engines run, and the explanation of their capacity and size relative to their four cycle predecessors is apparent.

The scavenging air is supplied by the tandem piston pump located at the far end of the engine from the flywheel and driven directly from the crankshaft.

Individual cylinder fuel injection pumps are used and are located opposite their respective cylinders within a special enclosure at a convenient height above the floor level. They are driven from the camshaft which runs along inside of the crankcase just above the crankcase doors, but the pumps themselves are in a separate compartment. They are quickly accessible by removing the covers along the side of the engine in front of them. These pumps are of the type where the quantity of fuel injected to the cylinders is controlled by the seating of the suction valve. The later the valve seats, the smaller the quantity of fuel injected. These pumps are controlled by the Woodward governor which can be seen at the near end of the engine just beyond the flywheel. The engine has an over-spread device independent of the governor set at 320 rpm.

The control station of the engine is just beyond the governor, and the gageboard is located on the end of the cylinder block as shown.

Very close attention has been given in this installation to the smoothness of operation of the unit. The engine has been carefully balanced, even to the placing of a small counter-balance weight inside of the flywheel rim. In order to make sure that the normal operating speed of the engine is well clear of all critical torsional vibration speeds, the generator has been placed several feet away from the flywheel. This changes the location of the critical speeds so that the nearest of these are well above and below the rated engine speed. This arrangement gives an incidental advantage. The stator is moved towards the flywheel for inspection purposes, and thus it is never necessary to disturb the slip ring brushes or cables for the process.

Since this new engine was installed in an existing station, the general installation details follow the station practices. The intake air for the scavenging pump is taken from the engine room. The fitting shown on the top of the side of the scavenging pump acts as a partial muffler of the intake noise. The exhaust leads upward from the header along the sides of the cylinders, from the middle of the length of the engine, and then turns horizontally and into the Maxim silencer. The latter is located horizontally inside of the engine room, and the outlet pipe leads through the back building wall and upward outside of the building.

In the station as at present arranged, the only intake air taken from outside the engine room is for the air compressors on the air injection engines. Staynew filters are fitted on these outside intakes. It is interesting to observe that it is never necessary to heat the station

*Exterior view of the Hudson Diesel generating plant as it appeared in 1935 when* DIESEL PROGRESS *first described this installation.*

in the winter time. There is enough heat radiated from the engines and exhaust piping to keep the engine room comfortable. In the summer time, ventilation takes care of the heat radiated.

The fuel oil used is Navy specifications Bunker A. It runs at about 20 Baume gravity and needs to be heated to about 100 degrees F. by the overflow jacket water in order to flow freely. It is supplied by Cities Service Co. by tank car spotted on the siding at one end of the station building. Motor driven Viking and Perfection rotary fuel transfer pumps unload the tank car into the two storage tanks of 20,000 gallons capacity each located above ground alongside of the building, and from there into the two day tanks in the upper part of the engine room. The latter have a combined capacity of 400 gallons and supply all of the engines by gravity flow.

All of the engines are started and stopped on light fuel. The operation of the engines on the Bunker A fuel has been very satisfactory, although the four cycle mechanical injection engine gave a little trouble until the injection valves were water cooled. The new two cycle engine has oil cooled injection valves also, and the operation so far on this fuel has been entirely satisfactory. Cuno and Nugent fuel filters are located on the individual engines.

Each of the later engines has its own lubricating oil system with a separate sump tank. Units four and five have oil cooled pistons. The cooling circuit is combined with the bearing lubrication circuit except that a higher pressure is used on the former circuit. From the sump tank in the basement to which the oil drains from the engine bedplate, the oil is pumped through a filter and cooler back to the engine systems. On the new engine, a Schutte Koerting filter is used and an Alco Products cooler.

Lubricating oil is continually being centrifuged and after 2000 hours use is removed and put in settling tanks for further purification. There are three De Laval centrifugal purifiers employed. One of these serves engine units 1 and 2; one serves units 3 and 4; and one serves unit 5. These purifiers operate at all times while the respective engine is running, or serves its units alternately. Texas Algol and Ursa are used, and a yearly average consumption figure of 1500 to 1600 kwhrs. per gallon of oil is obtained.

A closed cooling water system is used on all of the engines. Raw water from the nearby Assabet River is circulated through the heat exchangers. City water is circulated through these exchangers and through the engine jackets by Lawrence and Goulds pumps. The base of the chimney for the old steam plant is arranged to collect roof drainage and act as a soft water tank, it overflows into a hot well. The soft water system is now kept full automatically by a valve and connection from the city mains. The jacket water heat exchangers are arranged for separate, series or parallel operation to meet all operating conditions with by-pass to regulate jacket water 90-100° F. regardless of load conditions.

*Modernization and expansion have not been limited to equipment within as is clearly demonstrated by the present appearance of the same building.*

All of the electrical equipment was furnished by General Electric. This includes the switchboard, generators and exciter set. The earlier engines are also equipped with exciters, but they are held for standby service. All excitation is obtained from a motor generator set. Station current is generated as 60 cycle, 3 phase, 2300 volt.

There are eleven men in the operating crew. Besides the Chief Engineer, there are seven watch engineers and oilers, and three maintenance men. One of the watch engineers is a relief man to give the others one day off every week.

But what of the station performance? The plant has been turning out an average of 12.6 kwhrs. per gallon of fuel, and this record should be maintained or improved with the new engine. During shop test, the Alco-Sulzer engine showed a fuel consumption of 0.39 and 0.40 lbs. per bhp. hour at from three quarter load to ten per cent overload, using 28.5 Baume fuel with a viscosity of 37 seconds Saybolt, a high heat value of 19,149 Btu. per pound, 0.837 per cent sulphur, and 33 Diesel index.

The Light and Power department is under the supervision of Commissioner of Public Works, William P. Walsh chairman and Albert F. Shortsleeves, Clerk. Thomas C. Walsh is Manager of Light and Power Department. Mr. George D. Noiles is Chief Engineer of Station. In spite of the low rates for current, the Light and Power Department is paying into the town treasury a somewhat greater sum than they would pay as taxes, the cost of the plant has been depreciated to about two thirds of its original cost, and the Department credit balance is steadily increasing. The plant is a real success by any standard of measurement.

DIESEL PROGRESS told its first story of this plant in the June 1935 issue. This brings the account up-to-date, but considering the rapid growth in load and the latest addition to the equipment. there should be some interesting developments in the future.


# GENERAL SEAFOODS TRAWLERS

THREE new, deep-sea fishing trawlers with many engineering principles and modernized equipment never before utilized in such craft, were recently launched at the Fore River plant of the Bethlehem Shipbuilding Corporation for General Seafoods, a subsidiary of General Foods Corporation.

Mr. J. L. Alphen, Vice President and General Manager of General Foods stated at that time, "We believe these new boats represent the last word in scientific study of trawler construction. Heretofore, new trawlers have generally been designed from existing ships with slight modifications. We, however, decided in advance just what performance requirements our ships should meet and designed them accordingly."

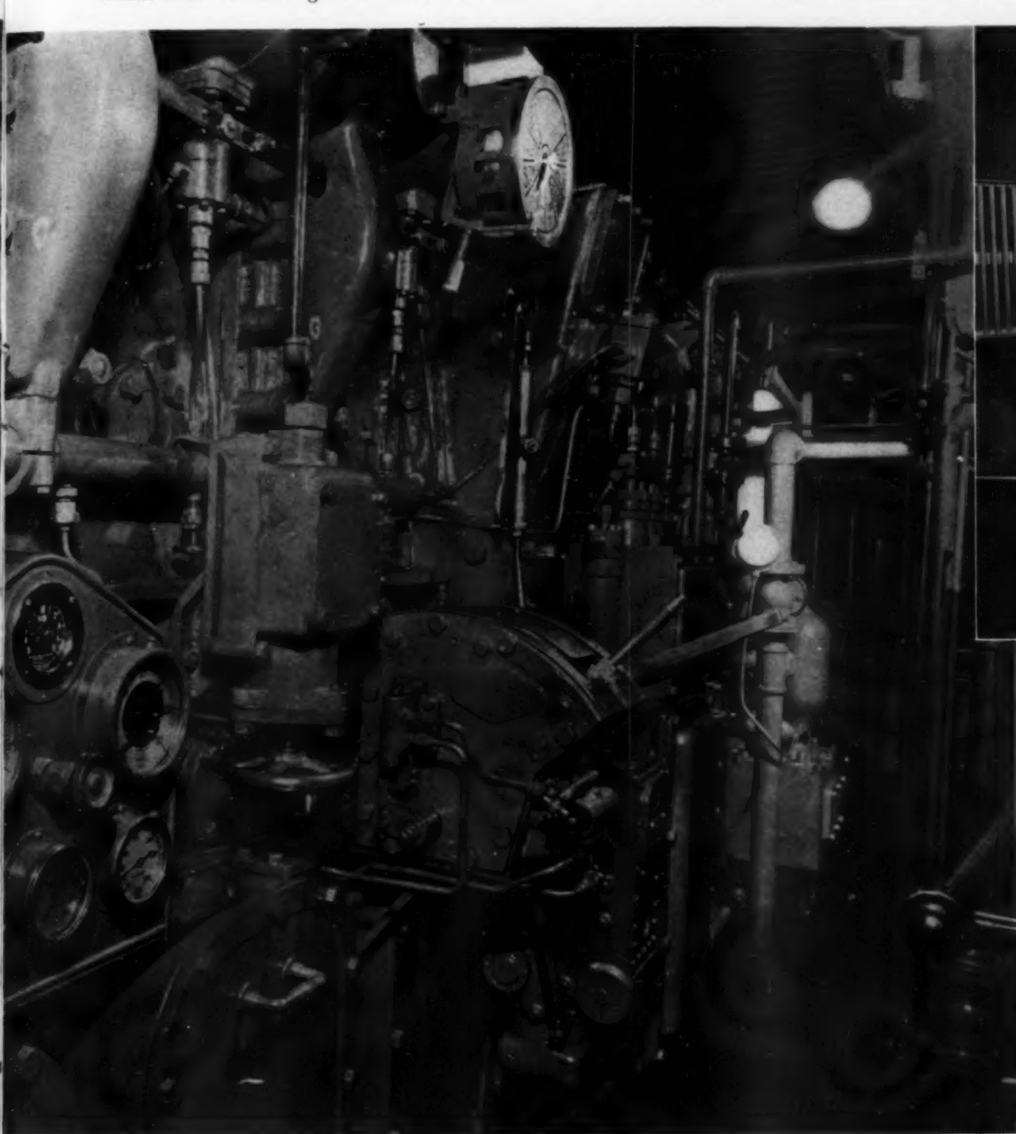
The three new additions to this famous fleet were designed by John G. Alden, N.A. of Boston. They are equipped with Maierform hulls following and in accordance with ship-model tank tests and conform to the highest classification of the American Bureau of Shipping. All three are exactly alike and have the following principal dimensions: Length 146 feet, 8 inches over all; moulded beam 26 feet; moulded depth 14 feet, 4 inches. Speed is 12 knots under fair weather conditions and carrying an average load of 250,000 pounds of fish and ice. This will cut the average length of a round trip to the fishing banks from eleven to nine days. The three vessels represent a total investment of approximately $800,000.00.

The Cooper-Bessemer Corporation furnished the Diesel engines for these boats equiping each with a 650 hp. main propulsion unit of six cylinders and a four cylinder, 140 hp. unit driving a Diehl generator supplying power to the large trawl winch. Two four cylinder, 40 hp. Lister Diesels also connected to Diehl generators furnish miscellaneous auxiliary power. The main propulsion engines are directly connected to the propellers through Kingsbury thrust bearings. Other engineroom equipment of special interest includes Weston electrical tachometers, Viking motor-driven

fuel oil-ballast pumps, Willard storage batteries, Maxim silencers, Brown pyrometers, Pickering governors, and DeLaval general service water pumps. The fuel-ballast pumps previously mentioned enable the engineer to transfer fuel oil from any of the three tanks to any other tank and thus trim ship to suit all conditions of loading. Particular attention has been paid to accessibility of all engine-room equipment. Both main and auxiliary Diesels are accessible from either port or starboard side. All arrangements have been made for maintenance with minimum time and trouble.

Returning to the design of these vessels brings to note a situation unique in fishing annals. For probably the first time, the fishermen, themselves, were consulted during the planning phase. General Seafoods, feeling that since the crews participated in the profits of their boats and therefore were vitally interested in their construction, asked captains, engineers and fishermen of the trawler fleet for practical suggestions to produce maximum fishing efficiency plus additional crew comforts.

"The specifications with which we started", Mr. Alphen continued, "were: To bring into port a quarter of a million pounds of fish of highest quality despite weather conditions, at as high a rate of speed possible consistent with good operating economy and safety. To be able to fish in extreme weather conditions with safety to crew and ship. To improve working and living conditions for the crew. To be able to fish deeper than any other trawler had ever fished before off the Grand Banks. To have ample, dependable power under all circumstances. THESE SPECIFICATIONS HAVE BEEN MET." Thus Gloucestermen continue to "go down to the sea in ships", in the *Annapolis, West Point* and *Yale* and Diesel engines continue to make their trade more profitable, more comfortable and safer. General Sea Foods Corp. is to be congratulated.



*First of the three new Cooper-Bessemer Diesel trawlers on successful trials. Control station of the 650 hp. propulsion engine at left and, above, the 140 hp. auxiliary.*

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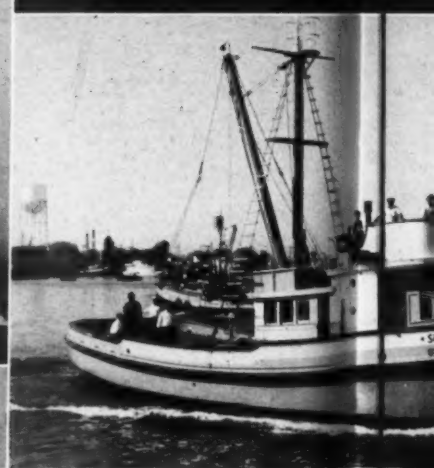




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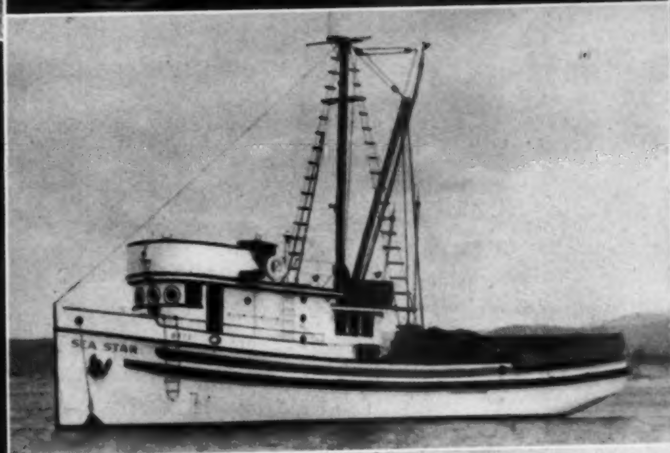
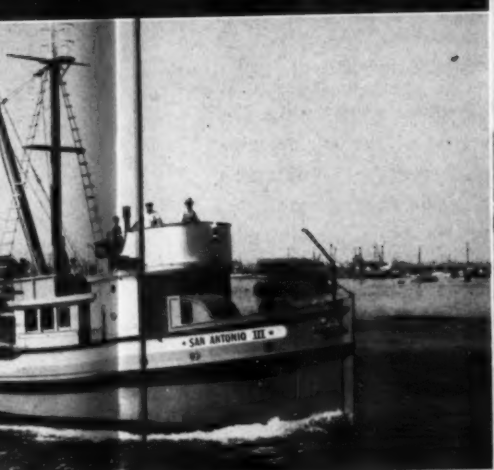
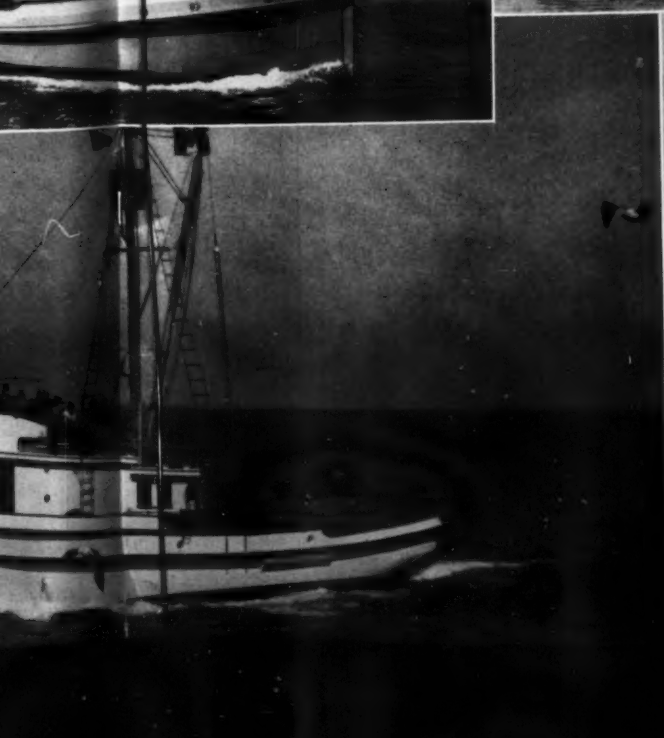
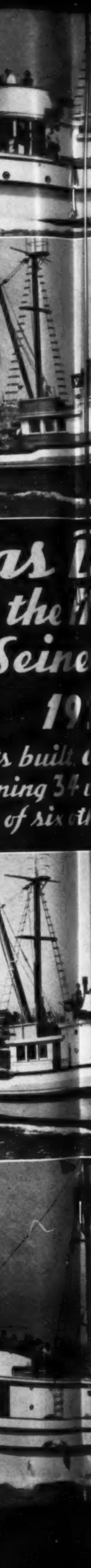
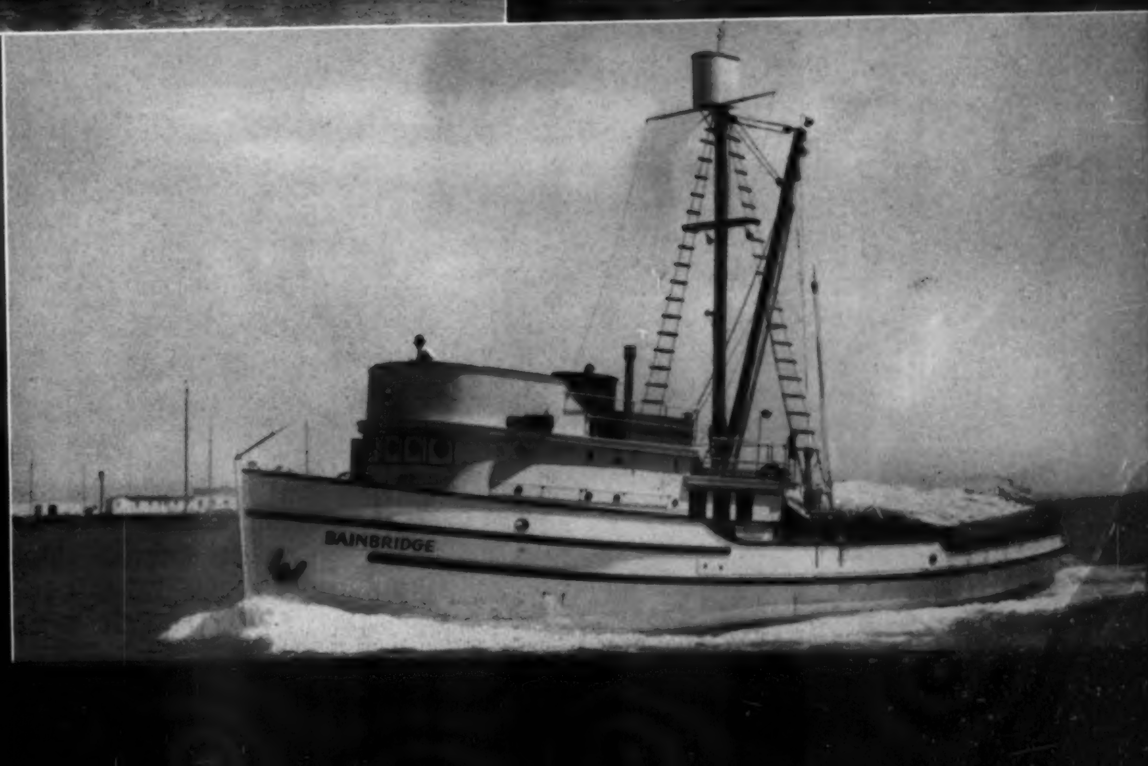




# STAHL—MEYER, INC.

## *Meat Packers*

*By* JOHN W. ANDERSON

ADAPTED to the space available, Stahl-Meyer, Inc., are finding their new Diesel plant the answer to their power problem. Other industrial plants, whether in the same line of business or not, may well study this installation closely.

Stahl-Meyer are widely and favorably known for their prepared meat products, and in their Brooklyn plant they need for their manufacturing processes and the general operation of the plant, steam, hot water, refrigeration and electric power. Previously they had their own coal fired boilers for the steam and hot water requirements, and they purchased their electrical energy from the local utility. The refrigerating compressors are driven by electric motors.

How could they cut the cost of their electrical power? An investigation indicated that Diesel engines could do this, but where was there space for them without a new building? Further study gave the answer in the present installation which provides a convenient and accessible plant with minimum building changes.

Adjacent to the boiler room was the old coal bunker, served by a siding from the Long Island Railroad tracks that pass the plant. This siding rested on concrete piers in the bunker. So it was decided to change the boilers to burn oil fuel, and use the bunker space for the new Diesel engine room. Fortunately, the piers were so placed that they extend only about one-third to one-half of the distance across the engine room, and they are far enough apart to provide ample room for the three Diesel units. The fuel storage tanks, one for boiler fuel and two for Diesel fuel, were buried under the floor of the garage, located on the other side of the boiler room from the engine room.

The illustration shows the three Diesel generating units of 135, 170 and 200 kw. capacity, respectively. In order to suit the existing motors installed in the plant, the Electric Machinery generators give current at 240 volts, 3 phase, and 60 cycles. The electric lights are taken care of by transformers which reduce the voltage to 120 volts. At the boiler end of the engine room there is the Roller Smith switchboard, fitted with the usual instruments, including a Simplex voltage regulator. These generating units are watched very closely for speed control, and on the switchboard there is a clock operated by Edison current alongside of the clock on the house circuit. There is also an Edison connection to the synchroscope so that the engineer can tell at any time whether his engines are running fast or slow.

As can be seen from the pictures, the exciters for the generating units are driven by a Morse silent chain that is fully enclosed and automatically lubricated.

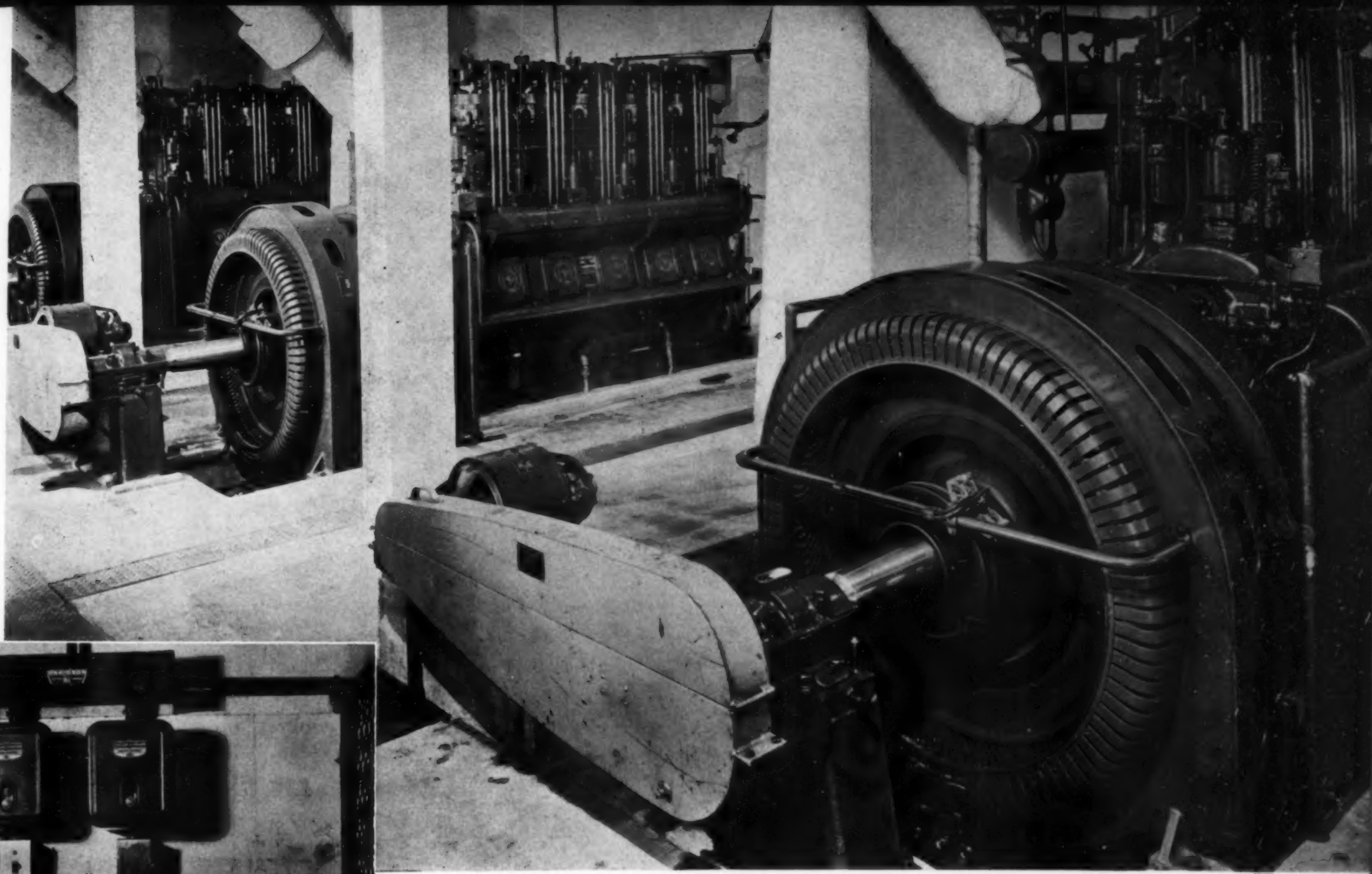
The Diesel engines were built by Chicago Pneumatic Tool Co., and have 4, 5 and 6 cylinders, respectively, being rated at 200, 250 and 300 bhp. at 400 rpm. It is a great convenience to have identical cylinder parts, yet the varying number of cylinders per unit gives flexibility in operation and makes it possible to maintain a high load factor regardless of load conditions. These engines are Chicago Pneumatic standard units and have already been described in detail in the DIESEL ENGINE CATALOG, Volume Two, page twenty-nine.

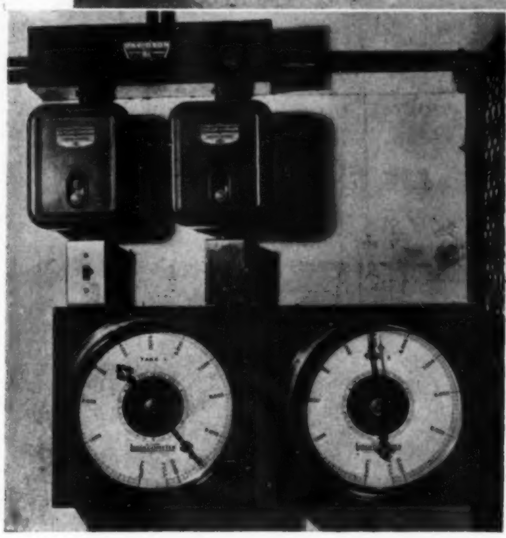
Each generating unit is bolted to its own concrete foundation block. Although this plant is located in a semi-industrial district, it was considered advisable to take precautions against transmission of vibrations. Accordingly, the four cylinder unit is supported on Korfund vibro-dampers and the other two units on Korfund cork mats. Underneath these there are the concrete sub-bases placed in between the old railroad siding piers. Trenches around each entire block isolate it from any side contact.

The air intake is from the engine room through Burgess filter and silencer units mounted on the engines at the ends of the intake headers. The exhaust is out from the end of each engine header diagonally upward and out through the side wall, and up through the Maxim silencer and riser above it.

Considerable attention was given to the fuel system. In the corner of the engine room near the switchboard are the Liquidometer gauges for showing the quantity of fuel in the storage tanks, the two day tanks, the two motor driven Viking fuel transfer pumps, and the fuel supply controls. Socony No. 4 fuel is used, and it is delivered by tank car on the railroad siding, although provision is made for filling the storage tanks by tank truck. From the two 10,000 gallon storage tanks the Viking transfer pumps deliver fuel to the 50 gallon day tanks. General Electric float switch controls keep the tanks filled at all times. On each day tank there is a Magnetron gauge, indicating the level of the fuel in the tank.

Viking transfer pumps on the engines take the fuel from one of the day tanks and deliver it to the injection pumps. Surplus fuel and drips are pumped back to the day tank. The system is so arranged that either day tank can





*General view from the switchboard of the three Chicago Pneumatic Diesels recently installed for Stahl-Meyer, Inc. Inset: Two of the three Liquidometer remote reading fuel tank gauges.*

be filled from either storage tank, and any engine can take fuel from either day tank. Of course, the returns from any engine must go back to the same day tank. This is accomplished by a set of three-way valves, so arranged in a group that a glance at the position of the valve handles indicates whether or not the valves are in their proper positions.

Clean fuel for the injection pumps is insured by the Nugent pressure type filters attached to the engines.

The lower part of the crankcase acts as the lubricating oil sump. Attached to the engine are the pressure pump, the Groco cooler, Cuno filter, and the Michiana filter. A part of the oil is constantly bypassed through the latter for a thorough cleaning. In addition, there is in the far corner of the engine room a De La Vergne reclaimer for batch cleaning of the Socony Vacuum lubricating oil.

A closed cooling water system is used. Main and standby motor driven Goulds circulating pumps, rated at 150 gallons at 75 feet head, take their suction from the surge tank over head in the engine room, and deliver through the Davis Engineering heat exchanger to the engine jackets. The overflow is back to the surge tank. Surge tank, heat exchanger, and circulating pump units are conveniently grouped against the engine room wall. Water comes from the engines at 160 degrees, and the engines operate the better for it. Raw water comes from an existing deep well pump, passes over the ammonia condensers, and through the heat exchanger to the roof tank for house use. On each engine there is a Fulton syphon thermostatic control that admits city water directly to the engine jackets in case of failure of the normal supply.

Starting air is supplied by a Curtis compressor driven either by an electric motor or a Novo gasoline engine. The air is stored in two tanks adjacent to the compressor unit at the end of the engine room, and in two more tanks at the far end of the room.

Over each engine there is an I beam and a Yale hoist. The Pickering governors on the engines are arranged for switchboard control for synchronizing the units. An Alnor pyrometer on the end of each engine shows the temperature of the exhaust from each cylinder. Viking safety controls protect each engine from low lubricating oil pressure or high cooling water temperatures. Except for the exhaust, all the piping and cables from the units are in trenches.

The installation is conveniently and attractively arranged. Design was by Edgar J. Kates, Consulting Engineer, and construction was under his supervision. Although the packing processes are not carried on continuously, nevertheless, a certain amount of refrigeration, light and power must be available at all times. This power plant must give central station service. Under the direction of Chief Engineer Frank Salg, it took over the load from Edison on October 13th. Operation of the plant has already been reduced to a normal routine, but it is a bit early to talk of operating results.

# MODERN DIESEL LOGGING

HIGH on the green mountainside the pitch of the exhaust on the Diesel-powered loader changes a little — there is a signal, and the last log of the load plunks down on top of other similar logs. The "top loader" steps down, carefully surveys his accomplishment, waves his hand. The driver of the huge Diesel powered truck steps on the starter, releases his brakes, and the load moves smoothly away down the steep private road that takes it to the landing.

Big loads these — 10,000 to 12,000 feet probably, or to give you a better idea of the size, from 80,000 to 100,000 pounds payload. The truck and its trailer weigh something like 30,000 pounds unladen, so you see what weight you have to contend with.

In spite of this, however, the load rolls smoothly along, at times on the straightaways the needle of the speedometer creeps above 30 miles per hour. As we approach a curve the driver moves his hand to the air brake valve, and we find this speed gradually reduced, enough to allow us safe passage around the curve. Some of these straightaways and gentle curves take us along for several miles, possibly averaging 7 per cent descent — yet the brakes stay with us, no fading or smoking, and we wonder. Then we remember the 150 gallon water tank mounted on the back of the cab, which is piped to each brake by a water distributing system and used during these rapid descents. Darn smart, these loggers!

As we glide along, the driver tells us many things about the interesting operation — that his boss formerly used large gas trucks, and that they used 10 gallons of expensive gasoline while making a trip with less load in more time than we are making it on 5 gallons, and that the savings in fuel alone amount to better than $250 per month while only running 150 miles per day per truck. He tells us also that this rumor about a Diesel truck not holding back on grades is to be discounted about 100 per cent, and that they have time studies in the office to show that the Diesel trucks make better time descending grades than the gas-powered units.

He tells us, too, about the increased speed the Diesel trucks will make on the grades returning empty, and listens attentively while we explain the Diesel principle which produces such high torque and gives him such lugging ability and increased performance.

Soon we reach the tidewater, roll quietly up to a "landing" where we prepare to "dump" these logs into the water. We are possibly 35 to 40 feet above, and slightly back from the water, and a huge slide has been prepared out of other logs so that the load will roll clear from the tide and the shallow water of the bay.

A cable has been slung under the load — the men step back and a cavalcade of logs charges down the slip, mountains of water piling into the air at the shock. Soon it is over and we turn to find that our truck has already gone. Gone back for another load, and then another and another.

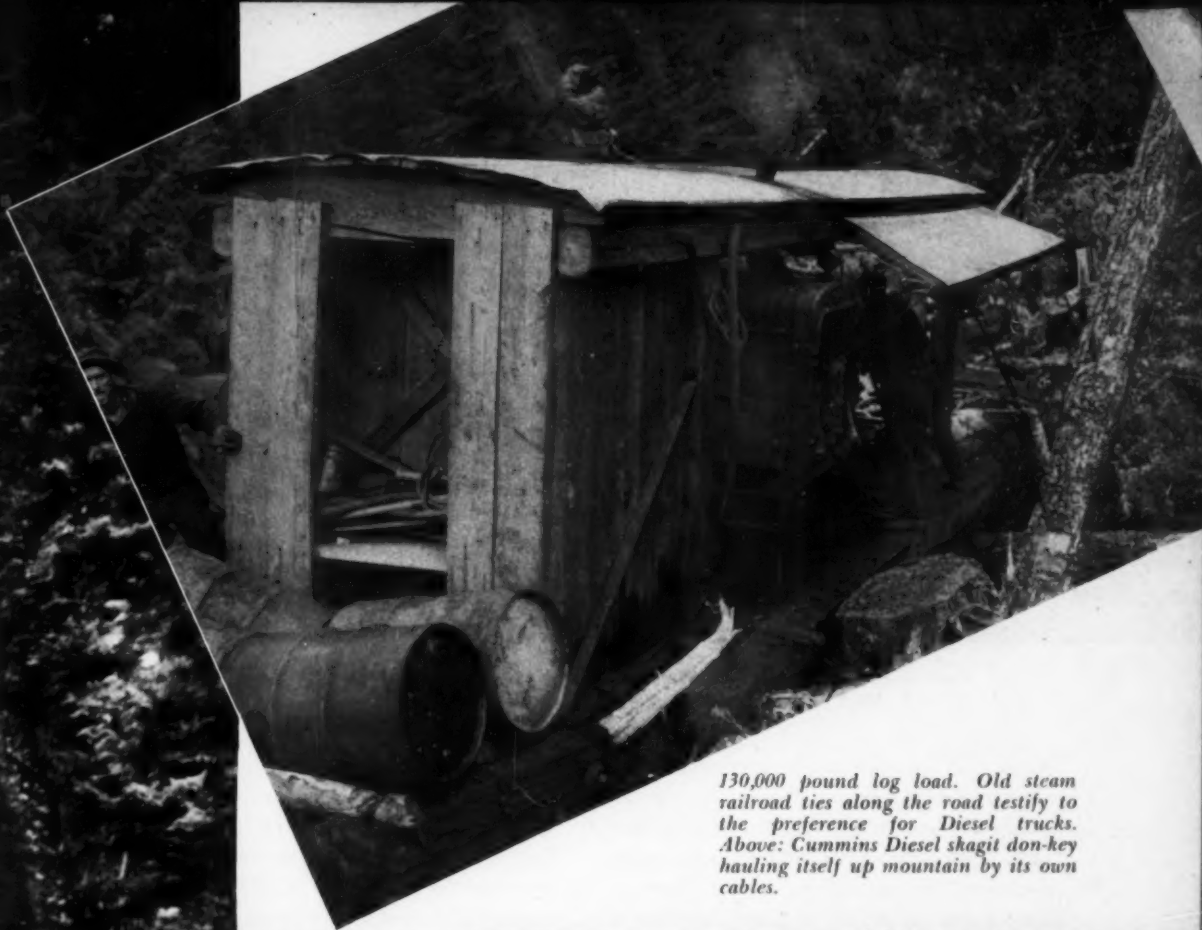
No hurrying, scurrying men. No particular excitement. Just the everyday thing here. These big loads are just part of the daily game — a very important part of it. For unless the logs roll through camp, the foreman tells us, he can't show a profit. And they must roll through in volume and with a regularity that spells one thing all loggers strive for: CHEAP LOGS.

Down in the bay a Diesel-powered "booming tug" bustles around in and out, preparing huge rafts of these logs; separating the cedar from the fir, the spruce from the hemlock; getting the short logs into one boom and the longer ones into another. It's job is a 24 hour per day one; top speed all the time.

Soon its big sister, the large Diesel tug with as much as 600 hp. in her, will be back for another "tow" for the hungry mill, which might be as far as 300 miles away.

That is the romance of the transportation side

*Twenty-four such car loads per day is the production of six Cummins Diesel trucks over a 14 mile haul with heavy grades.*



*130,000 pound log load. Old steam railroad ties along the road testify to the preference for Diesel trucks. Above: Cummins Diesel skagit don-key hauling itself up mountain by its own cables.*

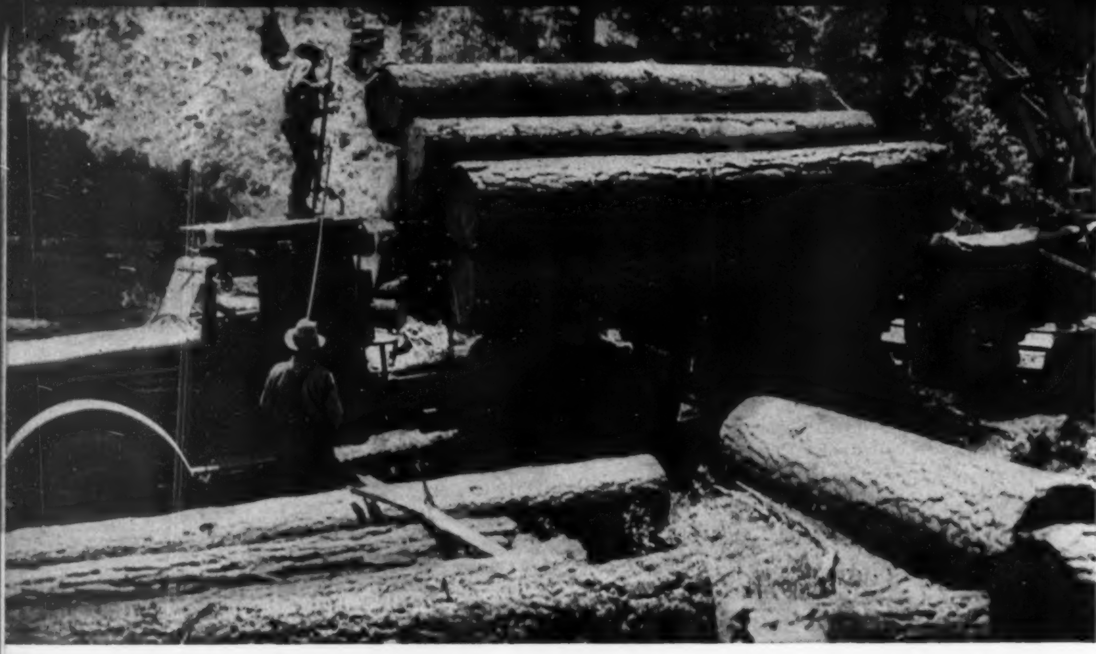
*Diesels in both loader and truck give maximum log handling economy.*

of the logging industry — all depending on the cheap transportatoin of the forest product to the mill, and then on to its ultimate consumer. Other transportation factors enter into this story of logging, too, so let's look at them.

Visualize a mountainside of huge fir trees, some measuring 12 to 16 feet in diameter at the butt — 200 feet high, these giants. We have to look "straight up" at this harvest scene that is about to be, for it's all grade between us and the top of the ridge, 2,000 feet away — mostly up. We have constructed a road up this valley, and we are now to engage in removing the yield from both sides of us. Does it look impossible? Not with the modern Diesel logging equipment!

Soon an army of fallers and buckers, who will "fall" the trees and "buck" them up into suitable lengths will invade this hillside. Husky Diesel-powered yarders, with their many drums and hundreds of feet of enormous steel cable, will be unloaded in an opportune spot and their crew will take a line up into the center of the area, tie it securely on to a stump or two, and the whining Diesel engine hauls itself across whatever may befront it, its 60 foot "sled" smoothing the way until it reaches the pre-selected "spar tree," which has not been cut down, but has been carefully "topped" and stripped of each and every limb. "High-Climbers" strap on their climbing equipment and soon the tree is "rigged" so that a complete system of cable stretches from the yarder's drums up to the top of the tree and out into the timber, then back to the "haulback" drum.

Soon this machine is in full operation, its operator answering the many signals received via an electric whistle mounted on top of the



*Caterpillar Diesel loading Cummins powered truck. This combination saves the driver's salary in full and adds one extra load per day over gasoline operation.*

engine, and operated by a member of the crew, who are completely out of sight among the underbrush and debris from 400 to 1,500 feet away. One sharp whistle and the frictions grab, the motor revs up, and on the end of a 1⅜ cable comes the log or logs that the "choker setters" have decided to burden it with. These logs are "cold decked" or piled in one large general pile, awaiting later handling. Maybe this donkey will work this "setting" a week; maybe longer, but soon it will again tear its torturous way through the fallen giants to another spar tree to repeat the performance.

Once the logs are cold decked, several things can happen. In the case of truck logging it is quite possible that the operator will build a spur road right to the pile, and a Diesel loader will be set into operation, swinging log after log with lightning rapidity into the awaiting trucks. If it is a railroad operation, or if the cost of construction of a spur would be too high because of the difficulties encountered as to grade and terrain, a Diesel-powered "slack line" or a skidder will be employed, which will make use of the spar tree still left standing, and together with another spar tree alongside of the track, where a siding has been arranged, will string a "skyline" which will have a carriage riding on it like a bicycle upside down, to be pulled backward and forward by a pair of drums on the machine itself, while a third drum raises and lowers the "skyline." Thus, the logs do not drag on the ground, and are easier to pull at the tremendous speeds that a skidder setting demands. Skidders are only put in where great production can be obtained, for their work is simply the one of transportation.

Sometimes these skyline cables stretch between trees as far as 2,400 feet apart, at times transporting the production from the hillside or valley opposite us; over a river or a deep chasm; sometimes with the logs as high as 400 feet in the air. All this to get the one all-important thing—CHEAP LOGS, and it takes economical transportation to do it.

Originally this was done by steam units, and sometimes multipled engines were employed. But steam is rapidly finding its way out on the logging of the Northwest. And, for economic reasons, that has to be.

A steam unit must be kept fired up all night long, in order to have power available the minute the men hit the job in the morning. A full-fledged engineer must be in attendance. There must be a fireman. Water must be supplied and sometimes this is a frightful job, necessitating the pumping through cast iron pipe from as far as half a mile away. Expensive and unnecessary with the modern Diesel. There is always a danger of sparks and resultant fires, and sometimes there is curtailment of production on days when the humidity has dropped because of this fire hazard. And reduced production means always increased overhead. Some of the steam units burned wood, and it was necessary to provide for that. Later on some burned oil, and there was a tremendous job of transportation to get the oil to the machines, especially when they left the track and lined themselves up the hillsides. They were heavy and cumbersome; their high boilers giving them a top-heavy influence that demanded far more caution in moving than was appreciated by the logger.

Besides, when the engine was coming in with a turn of logs, the cable coiling around the drums kept increasing the speed at which the log was coming in by increasing the diameter of the spool, thus necessitating more power from the engine. Unfortunately, this worked to a disadvantage for the steam engine, for the pressure had dropped in the boiler because of the demand on it. So the engine lost power as the demand increased, which wasn't a healthy situation.

So the steam unit finds itself on the down grade and new and modern Diesel power steps into the limelight. True, there have been more gasoline engines used on logging units in the past than Diesel, but that was because the Diesel engine hadn't found itself until of late. The lighter, higher speed, smaller dimensions Diesel engine of today, with its terrific power output and its unquestionable economy, is the answer to the logger's prayer.

This is especially true since the logging from now on will be confined to the steeper slopes and the more rugged pinnacles of the fir area. In the early days the loggers took that which came the easiest, passing up the tough spots because they could not, with the available equipment, be logged cheaply enough to compete with the logs gathered from the "prairies" that were still in abundance. Where the logging is to be done during the next several years will take power, lots of power, and the biggest percentage of this power will be Diesel.

"Donkey punchers" who have operated both gasoline and Diesel machines will tell you that there is no comparison to the lugging abilities of the two. The Diesel "stays with her" all the way in, they tell you, while the gasoline engine drops down in speed and necessitates the changing of gears to a pull that will allow the engine to again "rev" up and produce its rated power. The ever-watchful logging superintendent will tell you that there is a lot of difference in the cost of cold decking with gas and with Diesel, especially since the production will be "up" on the Diesel machine because of its torque characteristics and resultant additional ability to produce logs. And the Diesel machine, while producing more timber per shift, uses half as many gallons of fuel as the gas machine, and fuel costs half as much as gasoline.

Vital as is necessary the performance of the many methods of getting the logs piled at the siding awaiting loading, these would be of little value to the logs if there were not possible some some method of transportation that would land them at the mill at a price that would be competitive with other loggers and with other materials. As higher and higher we

. . . . *And now please turn to page 63*

*The "City of Denver" is typical of the Union Pacific's Diesel streamliner fleet.*

# UNION PACIFIC STREAMLINERS

*By* JOHN W. ANDERSON

THE Union Pacific Railroad Company is now operating six streamlined passenger trains in regular service and is soon to place in service two more such trains, which will be the longest and highest powered of all similar trains to date. It is timely then to review the discussion of this equipment presented by F. J. Jumper of the Union Pacific at the recent Summer Meeting of the Society of Automotive Engineers. Much valuable experience gained from the operation of the earlier trains, has been incorporated in the latest additions to the fleet. (See page 27.)

The first of these trains was a three-car articulated unit powered by a 600 hp. Winton engine using distillate fuel. It is now in daily operation between Saline, Kansas, and Kansas City, Missouri, and is known as the *City of Salina.* With three years of service to its credit, it has a record of some 350,000 miles to date.

The second train was originally built as a six-car unit and was powered with a Winton 900 hp. twelve cylinder V type Diesel engine of their usual two cycle railway type. It was this train which in the fall of 1934 reduced the transcontinental speed record of 71 hours to 56 hours and 55 minutes. During this run a maximum speed of 120 miles per hour was attained and between Cheyenne and Omaha. Over the Union Pacific tracks the distance of 508 miles was made at an average speed of 85 miles per hour. The total fuel cost of the entire transcontinental trip was $83.00.

Following an exhibition tour, this train was returned to its builders, the Pullman-Standard Car Mfg. Co. and a dining car was added. At the same time the power plant was rebuilt by substituting a Winton 1,200 hp. sixteen cylinder V type engine.

The train was named *City of Portland* and placed in service between Chicago and Portland, Oregon, in June, 1935. About two months later, due to a train service accident, the train was withdrawn from service, changes made as the result of operating experience, and in February, 1936, the train was returned to regular service. The run of 2,272 miles is made in 39¾ hours and five round trips are made each month. At this writing, the train has rolled up a total mileage of about 450,000 miles.

In May and June, 1936, two new eleven car trains, the *City of Los Angeles* and the *City of San Francisco,* were placed in service between Chicago and those cities for which the trains were named. These trains consist of a two-car power unit with nine articulated trailing cars back of them. The *City of Los Angeles* power unit has a Winton 1,200 hp. engine in one car and a 900 hp. engine in the other, giving a total of 2,100 hp. The other train has two 1,200 hp. engines, or 2,400 hp. total.

These trains also make the approximately 2,300 mile trip between terminals in 39¾ hours, and five round trips per month. To date, each train has some 340,000 miles in back of it.

In June, 1936, came the *City of Denver* trains, two of them. Each train consists of two power cars with a 1,200 hp. engine in each, and ten

*Appointments for passenger comfort in the new Diesel trains are as modern as their motive power.*

trailing cars — an auxiliary power and baggage car combined, a baggage-mail car, a baggage-Frontier Shack car, two articulated coaches, a diner-kitchen car, two articulated Pullman sleepers, and another sleeper articulated with a Pullman bedroom-observation car.

These trains make the 1,050 mile run between Chicago and Denver in 16 hours westbound at an average scheduled speed of about 66 miles per hour. Eastbound the schedule is 15 hours and 40 minutes. Each of these trains has made some 400,000 miles to date.

The illustrations in this article are of the *City of Denver* trains and typify the comfort and luxury afforded by the trains. In fact, their popularity with passengers plus the satisfactory operating record has encouraged the Union Pacific to build two seventeen-car trains which are to be placed in service soon.

The new trains are the longest and most powerful Diesel electric driven streamlined trains ever built. Each power car will be equipped with two Winton 900 hp. Diesel engines, making a total of 5,400 hp. for the train. The fourteen trailing cars will consist of an auxiliary-baggage-dormitory car, two coaches, diner-kitchen-diner, dormitory-club car, seven Pullman sleepers and an observation-lounge car. These cars are divided up into five two-car articulated units in one train and four in the other train. The diner-kitchen-diner unit is a two-car articulated affair with the kitchen-pantry located in the middle with different types of dining service on each side. Nearly 1,300 feet long and weighing about 1,600,000 pounds each, the new trains will replace the present trains to Los Angeles and to San Francisco.

Whereas the power cars of the *City of Denver* trains are built of high tensile alloy steel with the structure chiefly riveted, the new power cars are of all welded design. The new trailing cars are of high strength aluminum alloy with the exception of the bolsters and sill castings, which are of high tensile steel.

The main engines are of the standard Winton railway Diesel type, although there are some detail variations among them as the result of experience. But all have cylinders 8″ diameter by 10″ stroke and are rated at 75 hp. per cylinder at 750 rpm. The desired power per engine unit is obtained by using the required number of cylinders arranged in V form for the 900 and 1,200 hp. sizes. The features of these engines are the unit fuel injectors, the uniflow scavenging system, and the welded steel structure used to save weight. The unit fuel injector consists of a combined injection pump and injection valve unit in the center of each cylinder head. The four exhaust valves are arranged around the fuel injector unit and like the latter are operated from the camshaft. The scavenging air enters the cylinder through ports uncovered by the piston at the lower end of its stroke.

Each engine runs under the control of its own governor, and the control of the two engines in separate cars is affected by a remote electro-pneumatic system operated from the control station in the front cab. The engineer's throttle synchronizes the operation of the engines.

In the earlier trains, motor driven fans took the air entering the engine rooms through grills at the front end and at the sides of the power cars, and sent it out through the cooling water radiators located in the roof of the cars. This gave ventilation of the engine rooms and cooling of the jacket water. It was found, however, that too much dust entered the engine room at times, and the new trains have a separate ceiling under the radiators in the roof to confine the flow of air. In each power car, three power driven fans take the air in through grilles in the roof, blow the air through staggered longitudinally finned radiator coils, and out through the roof sheets. All of the engines are equipped with air filters on the intakes for the rotary scavenging air pumps.

In addition to the main Diesel electric power units, the power cars contain the air brake system air compressors, engine cooling system with fans, engine oil cooling systems, 64 volt storage batteries for starting the Diesel engines through low voltage windings in the generators, steam boilers for heating the trains, fuel and water supply tanks, electrical control equipment, and on the new trains the blowers for the traction motors.

Electric power needed for the auxiliary equipment such as heating, lighting and air conditioning, is furnished by auxiliary engine generator units. The present trains have six cylinder, four cycle Winton Diesel engines rated at 100 hp. at 1,200 rpm. direct connected by a flexible coupling to a 75 kva., 220 volt, 3 phase, 60 cycle generator with a 7.5 kw. 75 volt exciter. The latter is also used for charging the battery. The *City of Denver* trains have three such units. The new trains will have two auxiliary units, each consisting of an eight cylinder two cycle engine with cylinders the same as the main power units, but for this continuous service rated at 450 hp. and direct connected to a 300 kw. generator.

Heating boilers are of the flash tube type, oil fired, and two or three per train are located in the power cars. This gives flexibility to meet varying operating conditions. Each car has its own air conditioning apparatus, motor driven, with power supplied from the auxiliary generator units.

Many special train items have been developed for these units. The trucks, the braking systems, train telephone system, and headlights have all received attention. Extra powerful headlights were developed, using alternating current power. The present trains take their energy through transformers, but the new trains have motor generator sets running on the battery, ensuring operation of the headlights at all times.

The high speed of operation and the quick turn-around required of these trains brought their own special operating problems. Each train carries an engineer and a fireman for operating the power units and the train, and also an electrical supervisor for caring for the auxiliary electrical equipment and circuits. Train crews and service crews at the terminals were specially trained for the new work, which in many ways is different from that on the conventional steam trains.

Special arrangements were installed at division points for refueling, watering, etc., in order to reduce the delays and give more road time with a correspondingly lower average speed. Special terminal servicing facilities make it possible to replace a pair of car wheels in about 20 minutes, or an entire power truck in two or two and one-half hours. At the end of each trip, every part of the electrical equipment and running gear are carefully inspected.

Pistons, valves and bearings of the Diesel engines are removed and inspected after 50,000 miles of service, which on runs such as to Denver means about every six weeks.

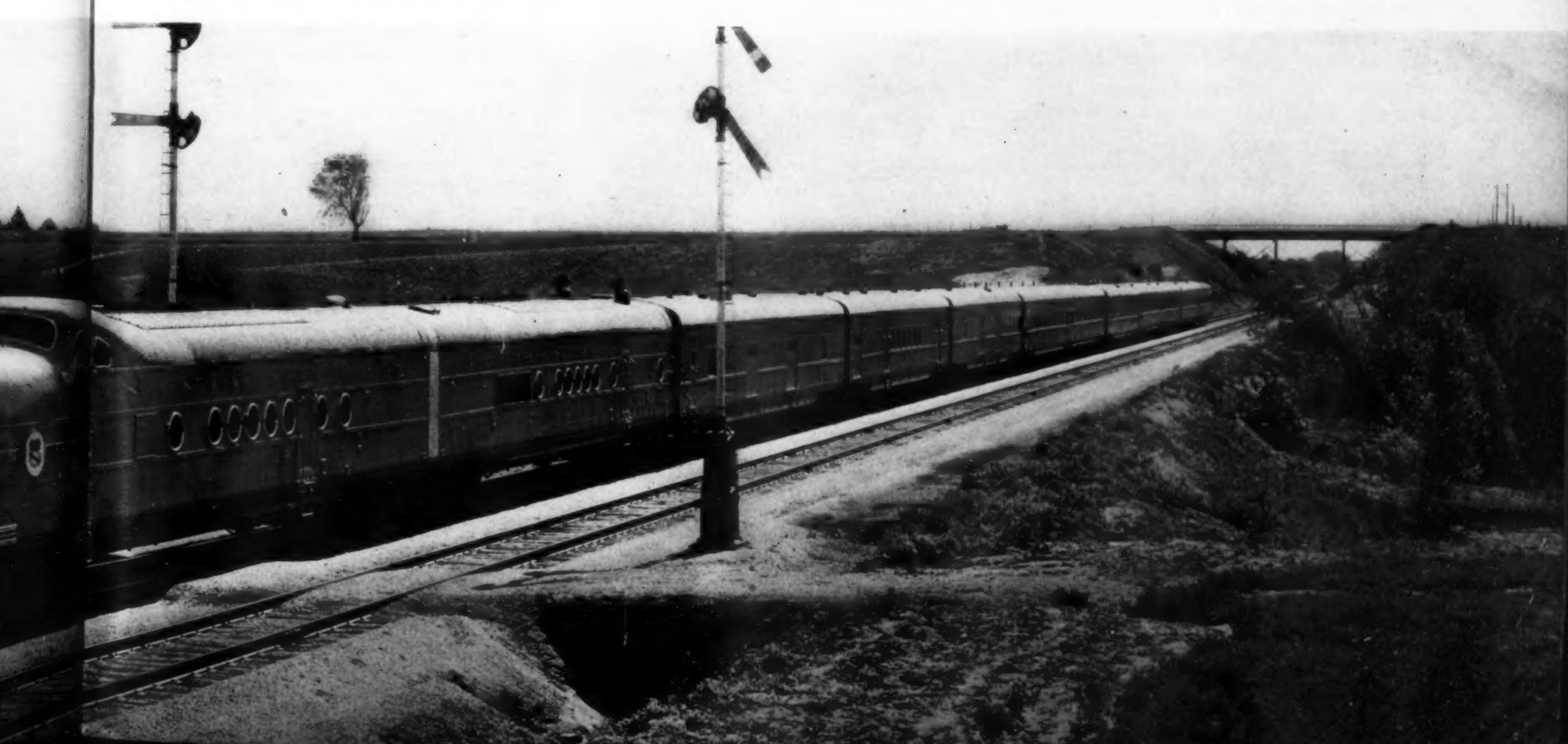
The Coast streamliners have their engine lubricating oil changed at the completion of every round trip, while the Denver trains have the change made every two round trips. This means the change is made about every 4,400 miles. The grade of oil used is SAE 50 with a viscosity of 87 seconds Saybolt at 210 degrees F. All oil drained from the engines is carefully reclaimed and reused. The 900 hp. engine requires 90 gallons for refilling, and the 1,200 hp. engine about 104 gallons.

The fuel used is a distillate having the following characteristics: Viscosity is 38 seconds Saybolt Universal at 100 degrees F, a flash point of 150 to 190 degrees F, and an initial boiling point between 340 and 400 degrees F. The average total fuel consumption per mile, including main power units, auxiliary units, and heating boilers has proved to be:

*City of Portland* —
7 cars, 1,200 hp., 1.11 miles per gal.
*City of Los Angeles* —
11 cars, 2,100 hp., .58 miles per gal.
*City of San Francisco* —
11 cars, 2,400 hp., .54 miles per gal.
*City of Denver* —
12 cars, 2,400 hp., .48 miles per gal.

The high thermal efficiency and the fuel economy of the Diesel engine has brought low operating costs, and long distance runs on a minimum quantity of fuel. This latter item is of prime importance on these long runs with short schedules. It will be interesting to watch the performance of the new seventeen-car trains.

*Safety, speed, comfort and economy are cardinal features of the new Diesel streamlined trains. Rising passenger revenues attest to the success of the Union Pacific Lines with Diesel equipment.*



*The New Jersey Porcelain Company's plant at Trenton.*

# TWO INDUSTRIAL DIESEL PLANTS

***The New Jersey Porcelain Company and Youngs Rubber Corporation***

*By* JOHN W. ANDERSON

TRENTON, New Jersey, has long been an important center for industry, and this is the story of how two companies have solved their power problems.

The New Jersey Porcelain Company manufactures a variety of procelain ware such as bathroom accessories, tiling, electric stove and coffee maker tops, refractories and porcelain parts for electrical fixtures. The process of manufacture of these parts is more complicated than the layman might suspect and has a distinct bearing on the power requirements for such an establishment.

First, the proper clay bodies are made up according to the needs of the final product by mixing several clays; the latter are obtained from many geographical sources and the portions of each used in the final mixture depend upon the characteristics of the original clays. The mixing is done in clay mills and in clay blungers (agitators to the layman). Presses squeeze the surplus water from these mixtures. Mixtures are dried by the waste heat from the kilns, and then are broken up in the crushers. Then they are wet with a hose, stacked for about twelve hours, ground, screened and then, with the addition of a little water to make them workable, are pressed into the shape of the finished article.

Baking is done in a tunnel kiln. The unbaked articles are stacked on cars and intermittently pushed in at one end of the kiln. As one new car enters at one end, a car of finished material is pushed out at the other end. The journey through the kiln takes about fifteen hours. This part of the process is continuous for twenty-four hours a day the year around.

At night power is required for lights, fans for the tunnel kilns and ball mills for grinding glazing materials. In the daytime there are still the kiln fans, and also the ball mills, clay blungers, clay pulverizers and the automatic power presses for tile. The load is fairly steady except for grinding the clays. These machines are heavily loaded, and when starting them up there are some heavy power swings. There are four 15 hp. motors and several tens. Average loads run around 25 kw. at night and about 60 kw. in the daytime, although under some conditions the load is greater than this.

Formerly the power was obtained from the local utility company, but considerations of economy brought the installation of the Diesel power plant that has been in operation since July, 1936. The kilns are oil fired and the plant is heated by steam. The stack for the heating boilers is evident in the picture of the plant.

When the decision came to install the Diesel plant, there was the problem of finding suitable space for it. In one corner of the plant are the heating boilers. Next along the side was the transformer room, where the electrical power cables came in from the outside. Then came the storeroom, ending with the shipping department in the near corner of the building. For the new Diesel power plant about 25 ft. of the end of the storeroom was taken next to the transformer room. This gave an amply sized engine room about 20 by 25 ft., as shown in the picture, and the former transformer room was converted into storage space for oil and supplies. The engine room is light and airy, and the space it occupies is not missed from storage.

Two Type B Worthington Diesel engines were installed. One is a four cylinder unit rated at 100 bhp. at 514 rpm. direct connected to a 66

kw. Crocker-Wheeler alternator. The other is a two cylinder 50 bhp. unit direct connected to a 33 kw. alternator. Comparing these ratings with the usual load figures, it is evident that the units operate with a good load factor at nearly all times. Current is generated at 240 volts and is 3 phase, 60 cycle. Exciters are V-belt driven at 1,750 rpm.

These Diesel engines are of standard Worthington design. Of the trunk piston, four cycle, mechanical injection type, they are fully enclosed except for parts of the valve gear and the fuel injection system. As the illustration shows, these exposed parts are open for inspection while running and for easy adjustment when necessary. Individual Bosch pumps and injection valves are used; pumps are driven from the camshaft, which is in the crankcase, but accessible by removing the cover along the front of the engine.

The two Diesel units with their generators were installed on one large concrete foundation block. This block is insulated from the building floor and walls, and there is no suggestion of vibration even when standing on the foundation block. The installation is very smooth and quiet running.

Each engine has its own air intake connection which comes down through the roof. An American filter unit just above the roof on each intake protects the engine from dust in the air.

The exhaust is up from the end of the engine header, runs along horizontally, and passes through the side wall to the muffler supported by brackets outside. The risers take the gases up clear of the roof line. These exhaust mufflers and risers can be seen on the side of the building.

The same fuel – No. 2 Tydol – is used for the Diesels, the kilns, and the heating boilers. It is stored in a 20,000 gallon underground tank just outside of the building, and the tank is filled from tank cars spotted on the railroad siding. For the Diesels, there is a 50 gallon day tank in the corner of the engine room. An automatic float control for the motor driven rotary transfer pump keeps the day tank filled with fuel from the outside storage tank. A hand pump serves as a transfer pump standby, and a Worthington fuel meter records the quantity of fuel delivered to the day tank.

From the day tank the fuel flows by gravity to the injection pumps on both engines. The only filtering the fuel gets is the strainer in the storage tank and the Cuno filter on the engine. The cleaning handle on this is turned about once a day, and the body is dropped and cleaned about once a month. Care is used in handling the fuel, and this simple cleaning process suffices.

These engines have their own lubricating systems with the sump in the engine base. A rotary pump on the end takes the oil from the sump and delivers through the Cuno filter to the cooler on the back of the engine, and thence to the built-in oil ducts inside of the engine that distribute the oil to all of the bearings. Gulf oil is used. Temperature of oil as it comes from the sump is about 160 degrees at full load. The filter is cleaned about every two weeks.

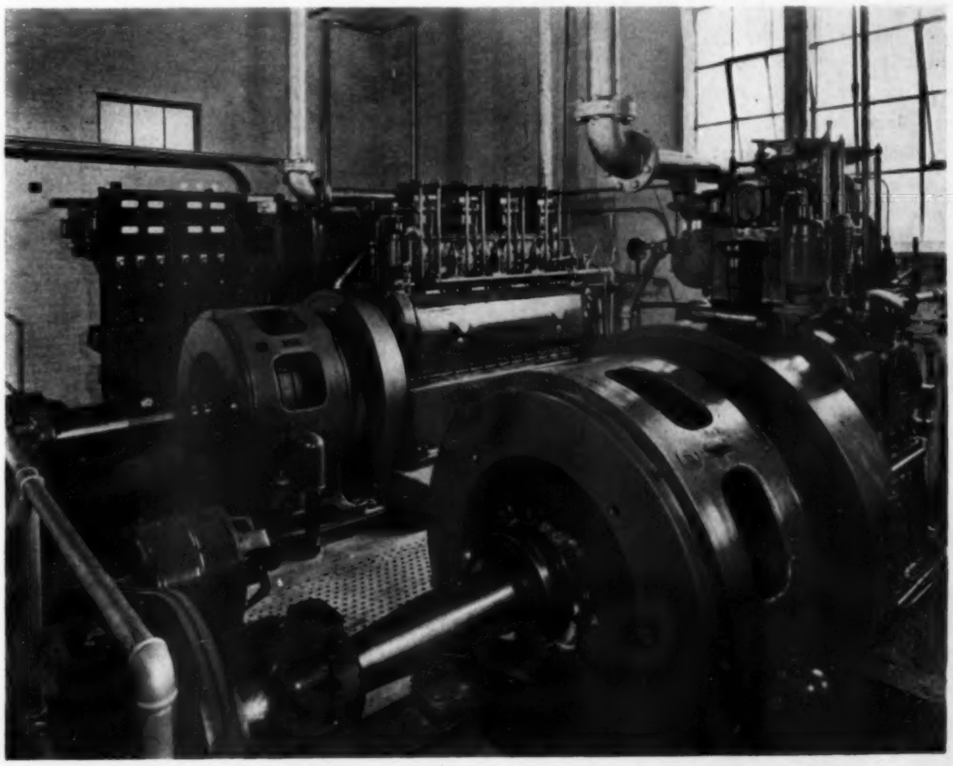
An open cooling water system is used with city water as makeup feed. A 250 gallon tank in the far corner of the engine room, on the floor, acts as a sump. Two motor driven centrifugal pump units alongside, one main and one standby, take their suction from the sump tank and deliver through the engine jackets to the small cooling tower on the roof over the engine room. From the tower, the water drains back to the sump tank. A float controlled feed supplies city water to the sump tank as needed. A manually controlled connection from the city supply can be used for cooling the engine jackets in case of failure of both pumps.

This cooling water comes off the jackets at about 120 degrees at full load. This city water supply is from the Delaware River and must be treated for hardness and for growth of algea. Chemical compounds are added to the cooling water regularly, and recently a screen has been placed in the top of the sump tank to catch the sludge and algea as the water drains from the cooling tower.

In the corner of the engine room with the cooling water tank and pumps are the starting air storage tank and the compressor set. The latter consists of an air cooled two stage Worthington compressor arranged for both motor and Novo gasoline engine drive.

Both Diesels are fitted with the following safety devices – high cooling water temperature, low water pressure, low lubricating oil pressure. An Edwards annunciator on the wall shows the engine and circuit at fault, and an alarm sounds out in the plant. Minneapolis-Honeywell instruments are used on the engine circuits. Each engine has its own Alnor pyrometer with connections for each cylinder.

The Roller Smith switchboard at the far end (in the picture) of the engine room has a Simplex voltage regulator. The Pickering governor on the larger engine adjacent to the board is adjusted by hand, but there is switchboard control for the smaller engine governor. The



*Two Worthington Diesels of 100 hp. and 50 hp., respectively, drive Crocker-Wheeler generators to furnish power at the New Jersey Porcelain Company.*

practice when synchronizing the two units is to bring the smaller engine in to meet the larger engine.

There is an I beam over each engine for a hoist for lifting the heavy parts when overhauling. There are a locker for spare parts and tools, a work bench, and testing equipment for the fuel injection valves. A spare cylinder head with valves, a set of piston rings, and a spare fuel injection valve are always kept on hand and in usuable condition. Exhaust valves get attention about every six months, and the fuel injection valves are inspected and tested about every three months.

The normal routine is to run the large engine in the daytime and the small one at night. The engineer on watch has many other duties, but plans to get back to the engine room at least every two hours to look things over and fill out the log sheet. Close attention is given to the speed regulation of these engines because there are several electric clocks around the plant. The engine room clock is compared with a wound clock alongside of it.

The engines have made an excellent record for themselves to date. Watt-hour meters for each engine unit show the output of that unit. A production of about 11 kwh. per gallon of fuel is being obtained. On the score of dependability or economy, the Diesels have the edge over the previous source of power.

Due credit for this must go to the day engineer, John Hart, who is responsible for the proper maintenance of the engines. He reports to Mr. F. J. Garson, Superintendent of the plant. Mr. J. R. Smith is President. The Diesel power plant at the Youngs Rubber Corporation, Trenton, N. J., is an interesting example of how such machinery can be fitted into space available and even use existing equipment no longer used for other purposes. Of course, the primary reason for installing the Diesel engines was to obtain a reduction in power costs.

The manufacturing processes of this company require heat and power. Power is needed for lights at night and for driving air compressors, ammonia compressors for refrigeration, fans and pumps. The heat is supplied from steam boilers, and incidentally, there is enough waste heat radiated from the processes to heat the building even in the winter time. Building heating is never a problem; rather the problem is to keep comfortable in the summer time. Electric power is used, generated by the Diesel engines. Formerly it was obtained from the local utility, and the current characteristics are those of the utility service.

There are two Diesel engine units installed. One of these has been in operation since early in 1935, and the other was placed in service about a year later. Both units are of the same type and size, although there are some minor differences between them.

In the normal routine, the manufacturing process proceeds from Monday morning until the second following Saturday morning – twelve days later. Then the plant is shut down until the following Monday morning. Either of the generator units will carry the load most of the time, and it is loaded at just about full load, although at night the load is a little less than it is in the daytime. The majority of the individual electric motors are not large, but the air compressor and the ammonia compressor motors are. Since the ammonia compressor motor is normally operated intermittently, the practice is to shut down the air compressor temporarily while the ammonia compressor is running or start up the second generating unit for the time being. In the summer time, both engines are usually necessary for carrying the load.

It is obvious that these engines have no sinecure. They are well loaded and they must run continuously. But their record for dependability is better than that of the utility service, because of the failures of the latter during thunder showers.

As the photo indicates, the engine units and equipment are placed along one side of the room in space not otherwise used. The adjacent wall provides a convenient support for the piping, and since part of the wall is an outside wall, the exhaust is easily arranged. This engine room is also adjacent to the boiler room, which makes it convenient to have the fireman on watch oversee the Diesel engine.

Each of the Diesels is a standard Worthington four cycle, solid injection, six cylinder engine rated at 150 bhp. at 514 rpm. They are known as Type B units and are purposely designed to be self-contained and easily operated and serviced.

The electrical equipment for one of the units was furnished by the General Electric Co. and for the other by the Ideal Electric Co. The generators are direct connected and are 60 cycle, 3 phase, 240 volt machines rated at 125 kva. or 100 kw. at 80 per cent power factor. The exciters are V belt driven at 1,750 rpm. These exciters are placed relative to the generators to suit the floor space available for them at that point.

The switchboard is located against the wall at one end (the near end in the picture) and the control boxes for the motor driven pumps are on the wall alongside. Since the entrance to the engine room and the fuel day tank are near by, the layout is very convenient. As a further aid to convenience, the governor of the far engine has switchboard control for synchronizing. The near engine governor has a hand adjustment.

The switchboard is fitted with the usual instruments, including watt-hour meters and a voltage regulator. Transformers are fitted for providing the normal 110 volt current for the lights in the factory.

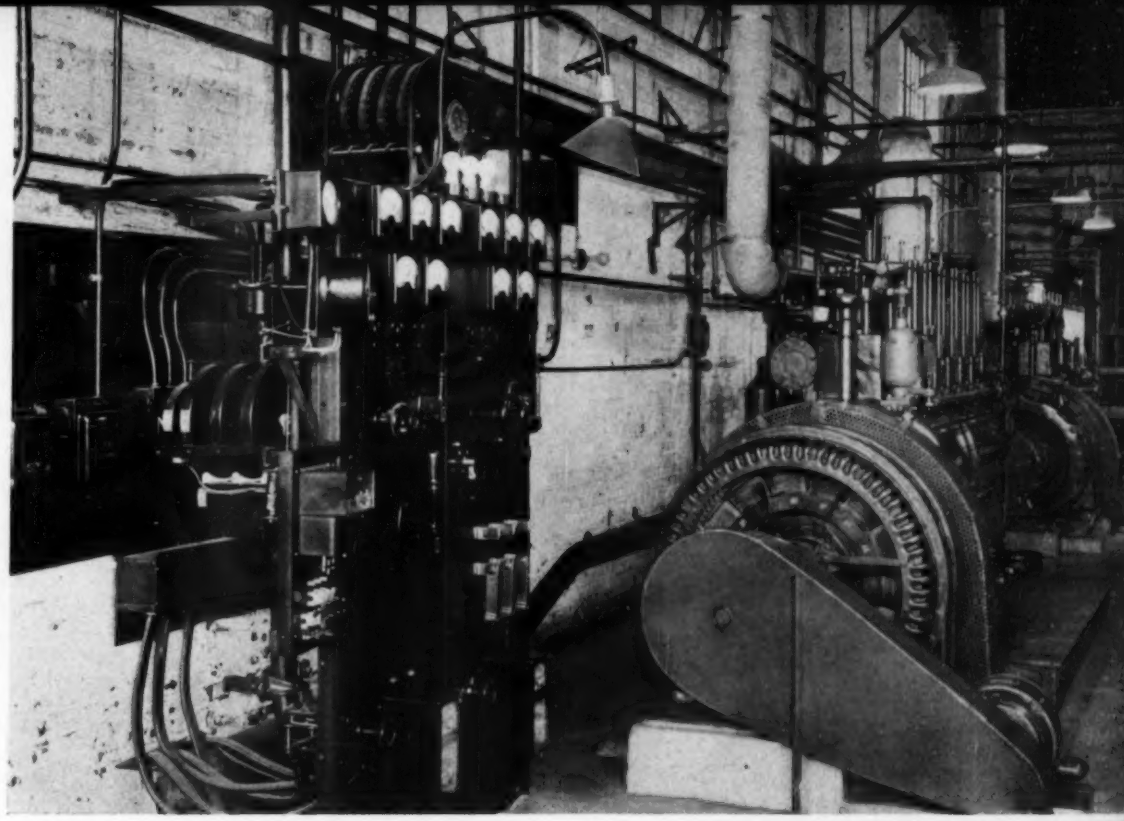
Intake air for the Diesels is taken through the roof with filters fitted on the inlets. The exhaust passes out through the side wall to mufflers supported from the wall by brackets. The tail pipe risers carry well up above the wall and roof line. The exhaust is very quiet, in fact, more so than is strictly necessary, since the plant is located in an industrial district.

Number 2 fuel is used and is delivered by tank car from the railroad siding which runs along the side of the plant, to the two storage tanks buried underground across the street. These tanks are of 6,000 gallons each and, although completely covered with earth, the axis of them is very little below street level. Inside of the plant, the engine room floor is several feet below the street level, and the transfer pump is at such a height that the suction lift is never more than a few feet and when the tanks are well filled there is a suction head.

The fuel transfer pump is belt driven from the motor, and the control is a push button. During the filling operation, the operator must hold his finger on the button. This filling operation takes only a minute or so, and it directs the attention of the operator to the fuel supply situation. On the side of the tank is a pointer operated by a cord over a pulley overhead from a float in the fuel day tank. The quantity of fuel pumped each time is recorded on the log sheet and this gives a record of the fuel consumption.

From this 50 gallon day tank, the fuel flows by gravity to the Cuno filter and the individual cylinder Bosch injection pumps on each engine.

Each engine has its own lubricating system which supplies all of the engine bearings. The sump is in the engine base, and the rotary pump on the end of the engine takes its suction from there and delivers through the filter to the bearings. There are no oil coolers on



*A pair of 150 hp. Worthington Diesels, one driving a G.E. generator and the other an Ideal, supply current for the Youngs Rubber Corporation shown below.*

these engines, and the temperature of the oil as it comes from the sump under full load conditions is about 160 degrees. It is the practice to drain the engine crankcase about every month of operation. No makeup is added during this period and it is found that about half of the oil has been used. After filtering, the oil is used again with the necessary additions of fresh oil. About a drum of Gulf Parvis F lubricating oil is used per month.

A closed cooling water system is employed. Treated and filtered city water is used in the engine jacket circulating circuit. It is circulated by a motor driven Worthington centrifugal pump unit mounted on the wall back of the engines. There is a special connection from the city mains for use in an emergency.

This soft water is cooled in the old shell and tube condenser formerly used for an ammonia refrigerating system that was otherwise removed before the Diesels were installed. This former condenser stands vertically at the end of the pit at the end of the engine room, and can be seen in the distant background of the photo. This heat exchanger is well adapted at the same time to act as a sump for the soft water circuit and the level of the water in it is high enough to provide a suction head on the circulating pump. Overflow temperature from the engine runs at about 110 degrees.

Raw water from the creek near by the plant is circulated through this heat exchanger also. A motor driven centrifugal pump provides the circulation.

Starting air is furnished either from the plant system or from the compressor set located just the other side of the engine room wall in the boiler room. This compressor set is the standard Worthington unit of this size with an air cooled Worthington compressor driven by a motor with a gasoline engine as a standby. The starting air is stored in three flasks located against the engine room wall back of and between the engines.

Each engine is fitted with a low lubricating oil pressure alarm, a low pressure cooling water alarm, and a high temperature cooling water alarm. There is also an Alnor pyrometer on the back of each engine with a connection in the exhaust from each cylinder. Temperature at full load runs a little over 600 degrees. On the frame of each of the generators and on the caps of the ring oiled outboard bearings there are also thermometers. The plant is well equipped with instruments for watching its performance and checking its operation.

There is an I beam over the engines to give a means of lifting the parts during inspection and overhaul. The usual fuel injection valve testing equipment and quota of spares and tools are on hand. The general supervision of the Diesel engines is under the maintenance engineer for the plant. He is responsible for all of the mechanical equipment throughout the plant and handles the Diesels along with the other items. Actual operation of the engines is taken care of by the fireman on watch. He starts and stops the engines as necessary, fills out the log sheet, keeps the fuel day tank filled, in addition to operating the steam boilers.

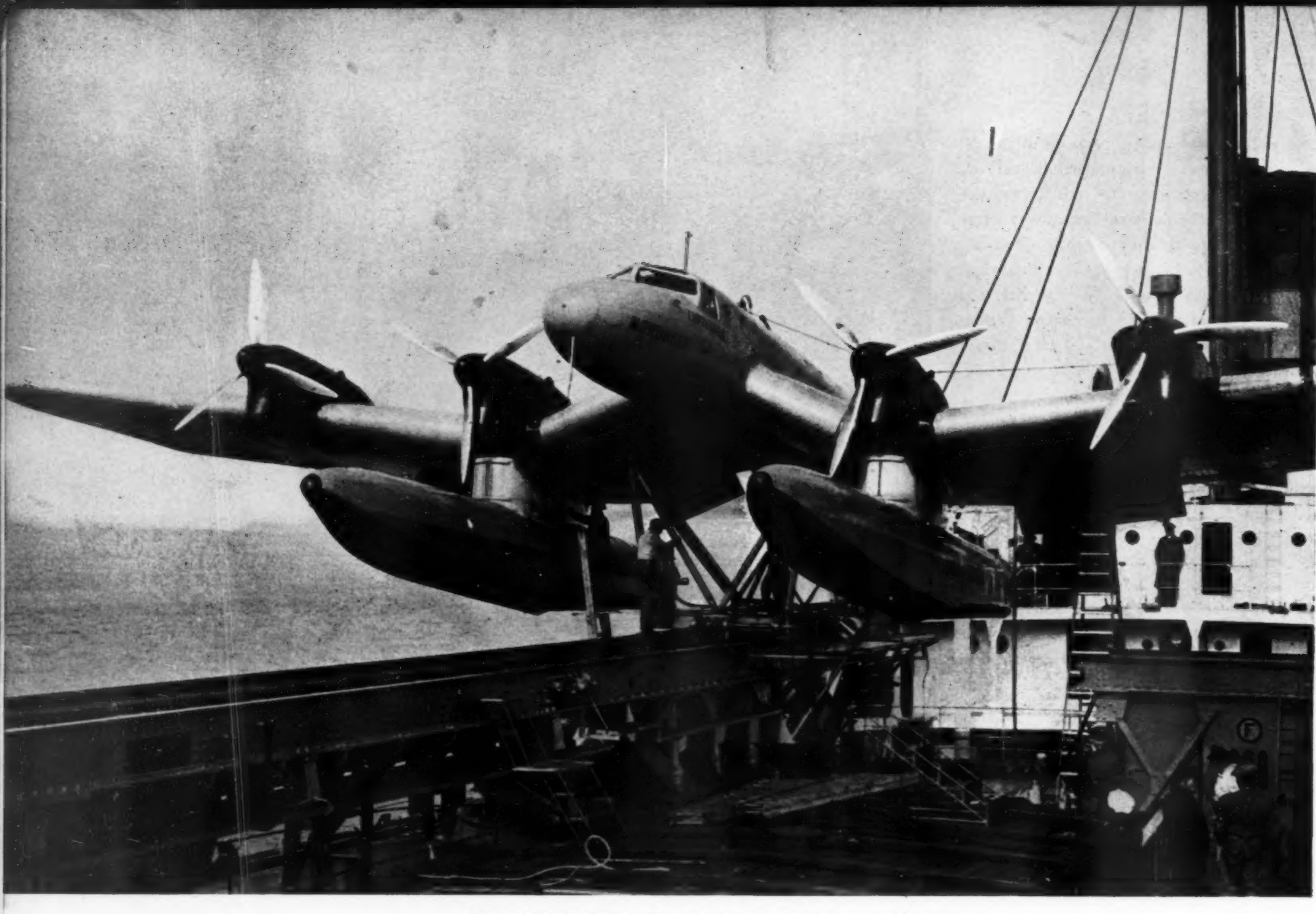
These Diesel units have proven themselves in every way. They have been dependable and have not given any trouble. And they have lived up to the anticipated economies. These engines will have completely paid for their cost of installation in about three years from the start of operation from the out of pocket savings in electrical power costs.

These two installations bring out several interesting points of vital importance to the owner of any plant using electric power.

First, the dependability of Diesel operation has been proven to these plant owners by their own experience. Note that in both cases, continuity of power was important to them on account of the nature of their manufacturing processes. And one owner installed his second Diesel on the basis of the satisfactory performance of the first engine. The Diesel plant gave the factories a character of service equivalent to and even better than that formerly supplied by the utility.

Second, the new machinery was installed in existing space not otherwise used. The layout in each case was adapted to the shape of the space available, and no new building construction was necessary. The cost of the new plant totalled only the machinery, its installation, and minor building changes.

Third, the new power plants are rapidly paying for themselves out of savings in power costs. After that, power costs will equal operating costs.



*DIESEL ENGINED! The "Nordmeer" on the catapult of the M.S. "Schwabenland," built for Deutsche Lufthansa of Germany.*

# FOUR-ENGINED AIRPLANES OF TODAY

*By* PAUL H. WILKINSON

MOST people who are interested in Diesel aeronautics are acquainted with the four-engined Hamburger *Ha 139* seaplane designed for transatlantic airmail service, as represented by the *Nordmeer* at the head of this aricle. On the opposite page is another four-engined seaplane, the *Mercury*, designed for the same purpose. While the Diesel-engined *Nordmeer* is launched into the air from a catapult, the gasoline-engined *Mercury* is to be carried high into the air on the back of a huge flying boat and then cut loose to continue its journey. In both cases the object in launching these mailplanes other than from the water is to enable them to attain flying speed with maximum loads of fuel and mail with minimum take-off risk. The composite planes – the *Mercury* and the *Maia* – are the products of the well-known firm of Short Bros. of Rochester, England, builders of the "Empire" type flying boats for Imperial Airways. At the start of their flight, both planes are locked together and are under the control of the crew of the lower unit. Although their combined weight is 47,500 lbs., they are lifted to an altitude of 10,000 ft. by the 3.980 hp. developed by their eight engines in less than 8 minutes. Then the lower unit relinquishes control of the upper unit and when the pilot of the latter is ready, he cuts loose and soars away from the supporting plane. This procedure, of course, has similar results to that of refueling a plane in the air after it has taken off with maximum payload and minimum fuel load.

The comparative table shows that while the German plane is considerably larger and sturdier than its British rival, its wing and power loadings are about the same. Another point of interest is that, although the *Nordmeer* has nearly double the horsepower of the *Mercury*, nevertheless, it carries only about 50 per cent more fuel. Assuming the fuel cost to be $0.08 and $0.20 a gallon, respectively, for the Diesel-engined *Nordmeer* and the gasoline-engined *Mercury*, it will be seen that a saving of $149.58, or 51.9 per cent, is made possible by Diesel operation. Furthermore, while only

*GASOLINE ENGINED! The "Mercury" pick-a-back plane on the "Maia," built for Imperial Airways of Great Britain. (Photograph from Wide World Photos, Inc.)*

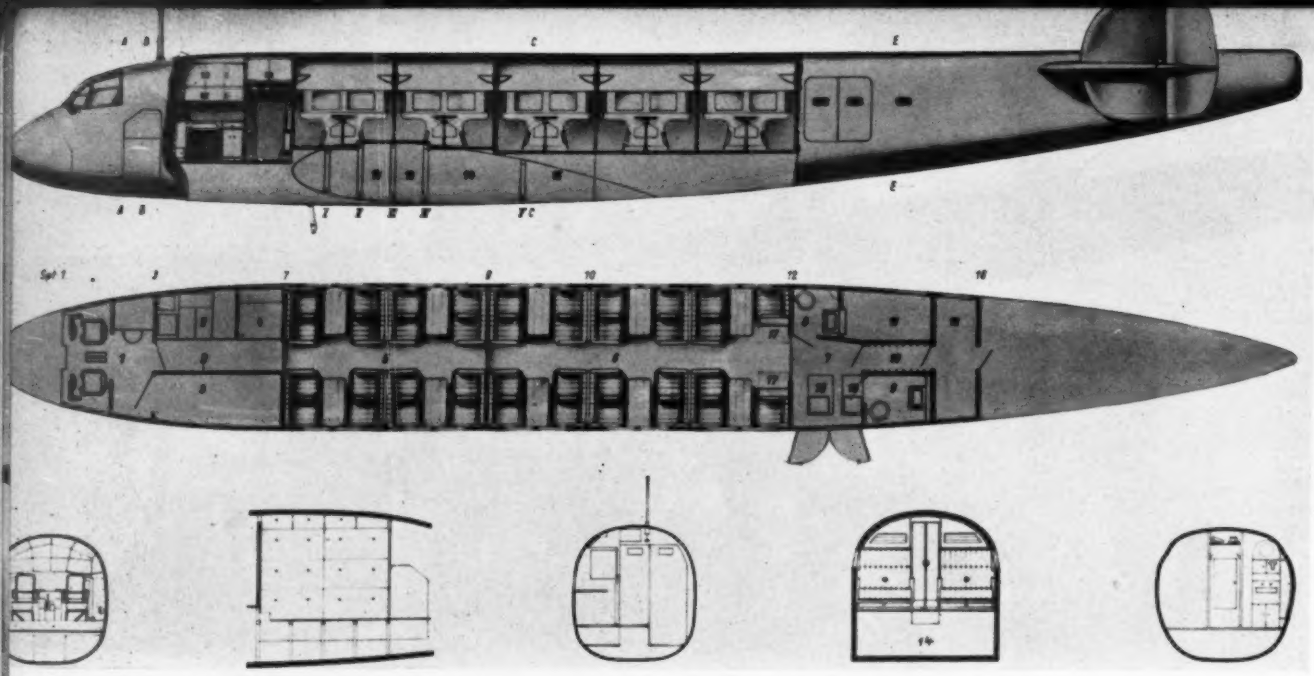
860 lbs. are available for crew and other items on the *Mercury,* the Diesel-engined plane has 3,170 lbs. available for this purpose, which means that it does not have to reduce its operating personnel and equipment to the minimum — a dangerous procedure for long-distance flights across the ocean.

Inasmuch as there has been a good deal of controversy recently about the Diesel aircraft engine, doubtless it will be of interest to our readers to hear what Mr. Arthur Nutt, Vice-President in Charge of Engineering, Wright Aeronautical Corp., has to say on the matter. In his article entitled "European Aviation Engines" published in the July, 1937, issue of the *S.A.E. Journal,* Mr. Nutt (who is a well-known figure in the gasoline airplane engine field) contends that in order to evaluate them, the Junkers "Jumo" *205-D* engine of 700 hp., weighing 1.63 lbs. per hp., or 2.2 lbs. complete, should be compared with an air-cooled gasoline engine weighing 1.4 lbs. per hp., and that a handicap of nearly 0.8 lb. per hp. has to be overcome by the Diesel.

Mr. Nutt goes on to say: "The German Diesel engines apparently can cruise at about 0.03 lb. per bhp.-hr. fuel consumption less than the gasoline engine, judging from the recent transatlantic flights, which means a saving of 600 lb. in a 20-hr. flight when cruising at 500 hp. per engine in a two-engined airplane, but 0.8 lb. per hp. on a 1,400-hp. airplane means 1120 lbs. additional engine weight. With this handicap in weight and since most flights are shorter than 20 hr., the value of Diesel engines must be considered carefully on a payload basis before entering into an expensive engine development program."

COMPARISON OF FOUR-ENGINED TRANSATLANTIC MAILPLANES

| | | |
|---|---|---|
| Country | Germany | Great Britain |
| Type | Diesel — seaplane | Gasoline — seaplane |
| Name | *Nordmeer* | *Mercury* |
| Wing span | 88 ft. 7 in. | 73 ft. 0 in. |
| Length | 64 ft. 0 in. | 50 ft. 11 in. |
| Wing area | 1,259 sq.ft. | 611 sq. ft. |
| Empty weight | 20,988 lbs. | 10,000 lbs. |
| Fuel | 12,100 lbs. | 8,640 lbs. |
| Payload | 1,100 lbs. | 1,000 lbs. |
| Crew, etc. | 3,179 lbs. | 860 lbs. |
| Flying weight | 37,367 lbs. | 20,500 lbs. |
| Wing loading | 29.7 lbs./sq. ft. | 33.6 lbs./sq. ft. |
| Power loading | 15.5 lbs./hp. | 15.0 lbs./hp. |
| Engines | 4 Junkers "Jumo" 205-C | 4 Napier "Rapier" V |
| Total power | 600 x 4 = 2,400 hp. | 340 x 4 = 1,360 hp. |
| Maximum speed | 190 mph. at 11,500 ft. | 207 mph. at 13,000 ft. |
| Cruising speed | 155 mph. at 11,500 ft. | 180 mph. at 10,000 ft. |
| Rate of climb | 547 ft. per min. | 580 ft. per min. |
| Range | 3,100 miles (20 hours) | 3,800 miles (21 hours) |
| Crew | 4 | 2 |
| Fuel cost | 1,729 gals. x \$0.08 = \$138.42 | 1,440 gals. x \$0.20 = \$288.00 |
| Saving in cost | \$149.58 or 51.9 per cent | |



*Plan and sectional views of the 40-passenger Junkers Ju 90 transport: 1 — Pilots' and Radio Operator's cabin; 2 — Pantry; 3 — Baggage room; 4 — Cloak room; 5 — Smoking compartment; 6 — Non-smoking compartment; 7 — Entrance hall; 8, 9 — Toilets; 10 — Cloak room; 11 — Mail room; 12 — Baggage room; 13, 14, 15 — Freight compartments; 16 — Baggage room for crew; 17 — Convertable seats for stewards.*

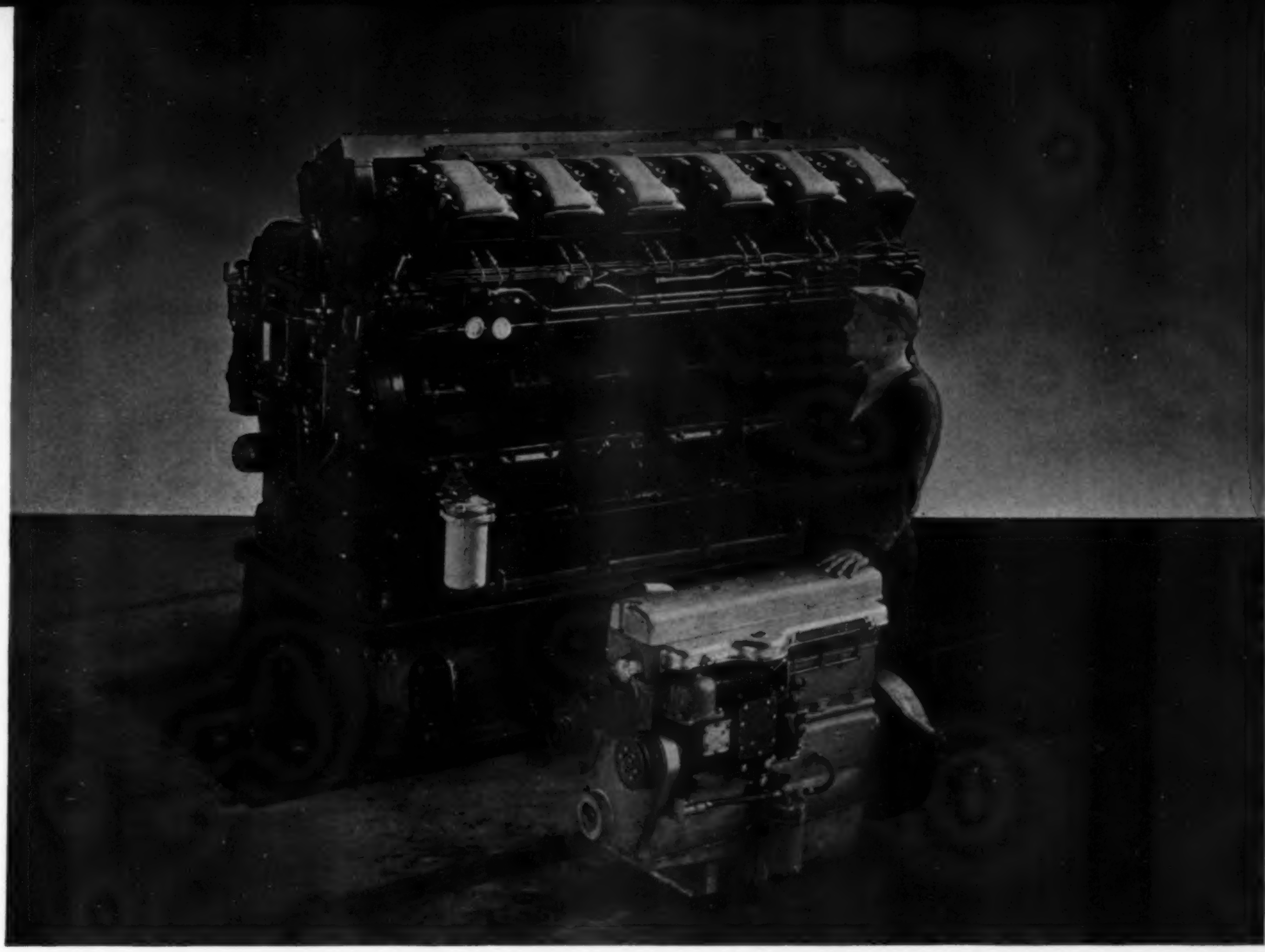
Now, let us get down to facts. *First,* Mr. Nutt suggested a comparison between the two engines, but failed to give his figures. *Second,* he asserted that an additional weight of 0.57 lb. per hp., or a total of 399 lbs., must be added to the Diesel to "complete" it, but he did not state what this additional weight comprised. *Third,* since it is common knowledge that the fuel consumption of the Junkers "Jumo" *205* Diesel does not exceed 0.36 lb. per hp./hr. at cruising speed, while the best figure for the gasoline engine in regular service is 0.43 lb., there is a fuel saving of 0.07 lb. per hp./hr. in favor of the Diesel, and *not* about 0.03 lb., as Mr. Nutt would have us believe. *Fourth,* two Diesel engines cruising at 500 hp. each would save at least 1,400 lbs. in fuel during a 20-hour flight compared with gasoline operation, and not merely 600 lbs., as Mr. Nutt states in his article. *Lastly,* with regard to the inference that flights of less than 20 hours' duration with the Diesel engine are of problematical value, Mr. Nutt conveniently disregards the tremendous saving in fuel cost made possible by the use of Diesel fuel compared with gasoline, thereby omitting an extremely important factor from his calculations.

While it is true that practically all Diesel-engined flights (or of gasoline-engined craft for that matter) at present are of less than 20 hours' duration, this has not prevented a tremendous expansion in Diesel aeronautics in the past two years, as those who have studied the situation are well aware. Furthermore, there is no longer an appreciable weight handicap to be considered when using the Diesel even for short distance flights as is evidenced by the number of planes with this type of power plant now in use. It is amazing, therefore, that such a well known authority as Mr. Nutt should have deliberately tried to belittle the aircraft Diesel in this manner before the S.A.E. and the aeronautical world, and that apparently nobody in this country should have taken the trouble to check his statements to determine their accuracy.

Strange things indeed are happening to American aviation these days. Although the public does not realize it and those connected with the aviation industry who have some inkling of the truth are practically forbidden to talk, our much vaunted industry, both commercial and military, is in a critical position. With the loss of the landplane speed record recently to Germany, all the major world's aviation records are now in the hands of foreign countries. England has the altitude record, Italy the open (seaplane) speed record and Soviet Russia the long distance record. Virtually all that is left to the United States is the non-stop duration record established, ironically enough, by a Packard-Bellanca plane equipped with a Diesel engine which, despite the success which this type of power plant has had abroad, is still discouraged by those entrusted with our advancement in aviation.

Following the lead of Europe, next year we may expect to see four-engined (gasoline) transport planes on our airlines. Other countries already have had considerable experience with these planes—England with the Handley Page *H.P.42* and Germany with the Junkers *G 38.* Meanwhile, Germany has stepped into the lead and soon the first of its new crop of giant planes will be in the service of Deutsche Lufthansa. *The Great Dessauer,* as this particular 40-passenger Junkers *Ju 90* transport is called, is equipped with Junkers "Jumo" *211* gasoline engines of 1,100 hp. each, but it is expected that subsequent planes will have "Jumo" Diesels of about 1,000 hp. each as soon as they are released for commercial use. Although the *Ju 90* is 115 ft. 6 in. from wing tip to wing tip and has a passenger cabin nearly 10 ft. wide and over 34 ft. long, nevertheless, it is quite fast and has, in fact, a top speed of 256 mph. and a cruising speed of 224 mph.

*"The Great Dessauer" (Junkers Ju 90), latest addition to Deutsche Lufthansa's fleet. Top speed of this 21-ton airliner de luxe is 256 mph.!*



*Both of these are Cummins Diesels. This comparison gives some idea of the wide variety of engine sizes of this make which are available.*

# DIESEL ENGINES

*By* JOHN W. ANDERSON

### No. 19. CUMMINS

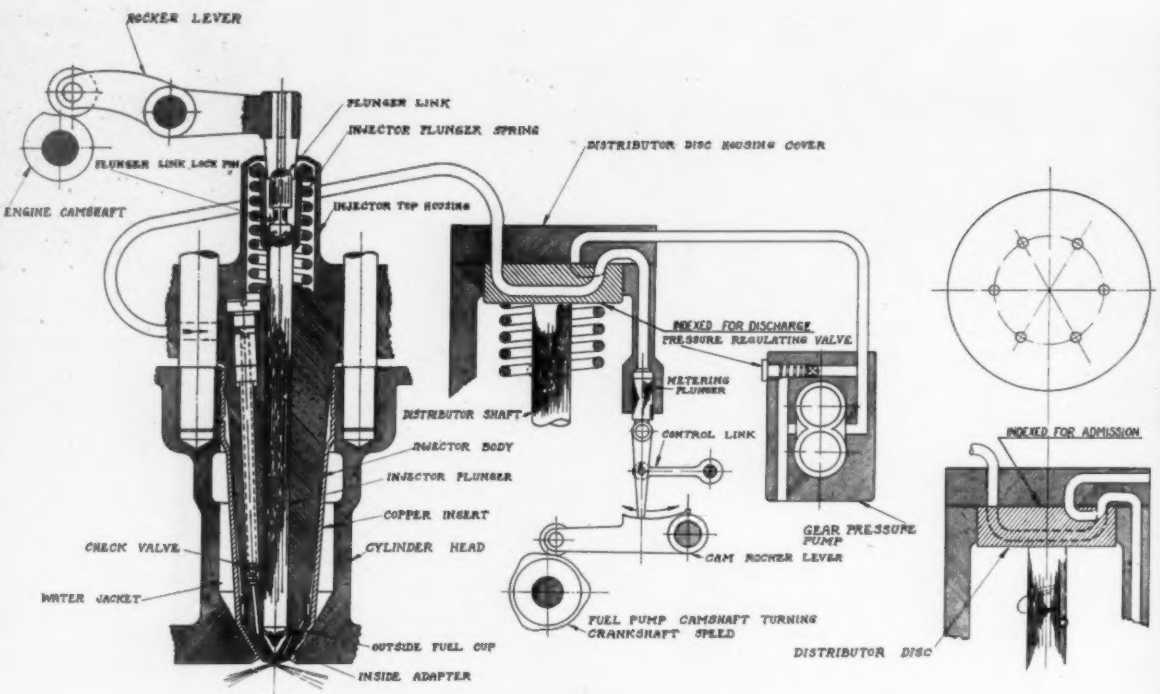
*This is but one of 57 engine descriptions which appear in the* Diesel Engine Catalog. *See page 60.*

FROM 40 to 500 hp. — that is the range for the Cummins line of Diesel engines. Since they are applied to automotive, marine, industrial power and railway service, the ratings for power and speed vary with the individual service applications. The smallest size is a four cylinder unit and the largest is a V 12 for railway work with cylinders 7″ by 10″. Intermediate sizes are built with 3, 4 and 6 cylinders per unit, depending upon the power needed and the service in which the engine is used. But all of the engines use the Cummins fuel injection system, all are of the four cycle type and the same basic mechanical design features are used throughout.

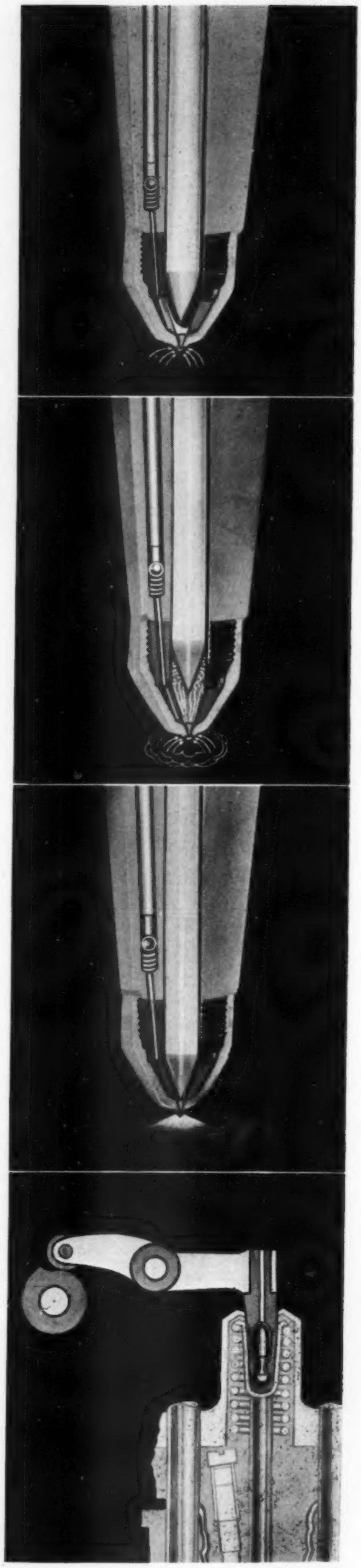
The Cummins fuel injection system is unique, and reference to the pictures will make its method of functioning quite clear. First, there is the gear pressure pump for maintaining a supply of fuel at constant pressure on the suction of the metering plunger. The spring loaded pressure regulating valve in the top of the pump (as shown in the illustration) bypasses the surplus fuel not used by the metering plunger back to the pressure pump suction. This insures that the metering plunger works under uniform conditions at all times, and hence gives a regular performance. For it is the metering plunger which carries out the highly important function of metering the correct quantities of fuel required.

Since there is only one metering plunger per engine, every cylinder must receive the same charge of fuel for a given setting of the fuel control. The metering plunger is driven by the fuel pump camshaft, which turns at crankshaft speed and has as many lobes on the cam as there are power impulses per crankshaft revolution. The illustration shows three lobes, as for a six cylinder engine. However, the cam does not act directly on the metering plunger, but drives the latter through the cam rocker lever. On the top of this is the arc over which the lower end of the driving link for the metering plunger swings. The position of this driving link is controlled by the control link, which is connected to the governor or hand control. Thus the stroke of the metering plunger is varied to suit the fuel requirements.

The fuel metered by the metering plunger is delivered through the distributor, which is




*Diagrammatic sketch of the Cummins Diesel fuel injection system and method of fuel metering.*



arranged to choose the proper cylinder for each individual fuel delivery. This sequence is, of course, the same as the order of firing for the engine.

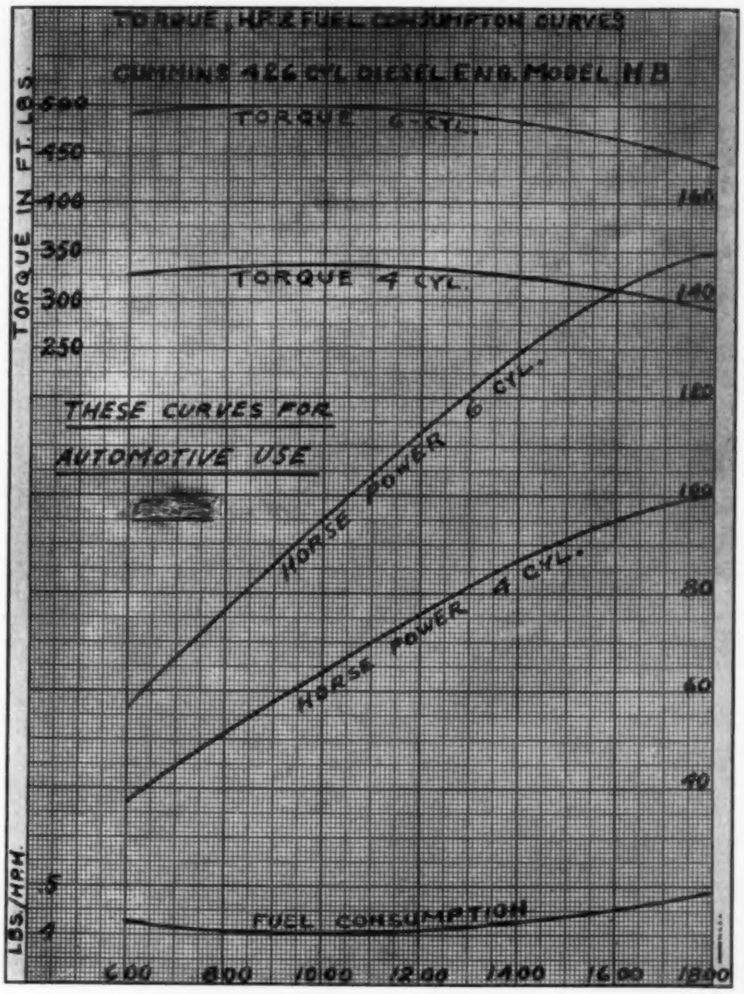
The illustration shows a section through the fuel injector. The fuel is delivered to the injector during the suction stroke of that cylinder, and it enters through the check valve at the side, and into the space below the injector plunger. In fact, the injector plunger is making its upward stroke at the time. Then during the compression stroke of the piston, the hot compressed air enters through the holes in the bottom of the injector and, forcing its way through the fuel inside, gasifies it. The fuel check valve in the fuel feed is, of course, closed and prevents any pressure from getting back into the fuel feed line.

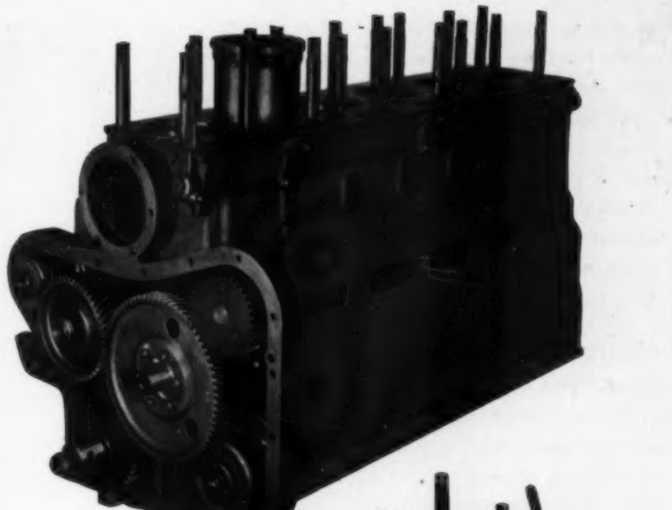
Towards the end of the compression stroke and just before the piston reaches top center, the injector plunger is driven downward by its cam and rocker motion. This forces the fuel and its gases out through the holes in the tip of the injector into the combustion space in the cylinder. The combustion chamber is formed in the top of the piston, and its shape and the fuel jets mutually conform to each other. Since the compression pressure for these engines is about 500 lbs. per sq. in., there is sufficient temperature to give a very prompt ignition to the fuel as it is injected. The rate of injection, and hence to a large extent the rate of fuel combustion and the course of the combustion pressure line, is controlled by the shape of the injector cam. The maximum combustion pressure is held to about 625 lbs. per sq. in.

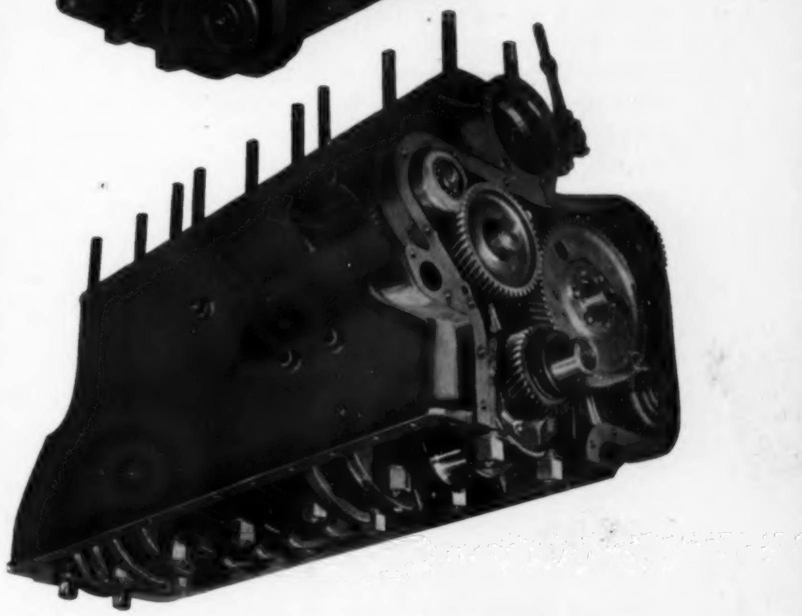
In the middle of the top of the piston, there is a cavity known as the cup wiper. The opening in the top of it is aimed directly at the tip of the injector valve. During the compression stroke, this cavity is, of course, filled with air. As the piston starts downward on its working stroke, the air in this cup expands and creates a blast on the end of the injector tip. This not only clears the tip of any tendency to form carbon, but it also provides air for combustion and local turbulence in the vicinity of the tip, with beneficial results. It sweeps away any zone of stagnant fuel and gases in the vicinity of the injector tip.

Note the copper insert set into the injector valve pocket in the cylinder head. This provides for a water jacket space around the valve and, since the injector is set down closely into this insert, the injector itself is well cooled.

*The three close-ups of the fuel injector show the fuel charge delivered to the spraytip and held suspended in the adapter cup, the compression stroke forces the hot air through the fuel charge creating a gaseous mixture and, lastly, the plunger is depressed forcing the gaseous fuel charge directly into the cylinder.*
*Bottom — Cam rocker arm which assures controlled injection of the fuel charge.*





The results of this combustion system are best shown by a performance curve. The one here is for the Model HB engines and is for automotive use only, but it shows the performance over a wide range of speeds. For industrial service, this same model of engine is rated at a maximum speed of 1,200 rpm., and maximum power ratings at that speed of 55 and 85 hp. for the four and six cylinder units, respectively. All of the curves are very flat for the entire range of speed.

The cylinder block and the upper part of the crankcase are in one piece for the entire engine. The illustration shows that for one of the engine models and brings out several features in connection with it. The cylinder liners are of the wet type and removable. The long studs on the top are for the cylinder heads. The opening on the end, just above the gear casing, is for the circulating water pump. There is a whole train of gears on the end. The end of the crankshaft and its gear can be seen driving the largest gear, which is on the end of the camshaft. The other gears are for the various accessory equipment, and they are far enough out in the casing to provide for connection to the accessories as they are placed along the sides of the engine. The bottom view shows the main bearings and the crankshaft in place in them. These bearings are of the precision type. The crankshaft shown has counterweights on every web. This is the practice for the models running at the higher speeds.

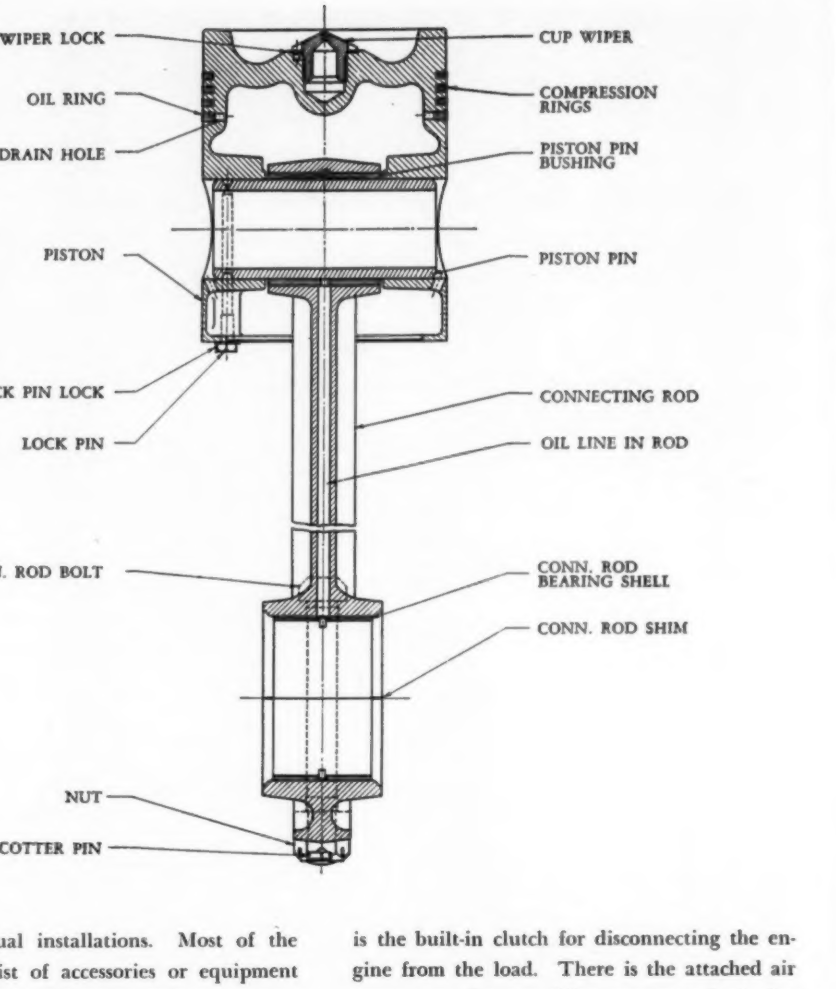
Cylinder heads are cast individually for the largest cylinder size, in pairs for the intermediate sizes, and in one piece for the entire engine for the smallest cylinder size. In all sizes the inlet and exhaust valves seat right in the head. In each cylinder there is the inlet valve, the injector valve, and the exhaust valve in line alongside of each other, and all of them must be operated from the camshaft. The rockers for this purpose, located on the top of the engine, are carried in a special assembly which is separate from but bolted to the top of the cylinder head. There are oil tight covers which go over the tops of these rocker assemblies.

These rockers are actuated by the push rods, which are entirely within the engine structure and rest at their lower ends on the cam rockers. Again these cam rockers carrying the cam rollers are combined in an assembly including a cover which bolts to the side of the engine frame. The cams are forged integral with the camshaft.

Pistons in the larger cylinders are of cast iron, and in the smaller cylinders of aluminum alloy. The section shows how the combustion chamber is formed in the top of the piston and also the cup wiper. Wrist pins are full floating and are held in place endwise by the lock pin which registers with the groove around the pin near one end of it. Crankpin bearing shells are of the precision type.

The general engine views show how the manifolds and accessory equipment are arranged on the sides of the engines. The inlet air manifold usually is fitted with a combined silencer and filter. The exhaust gas manifold is water cooled. The fuel metering pump with distribu-

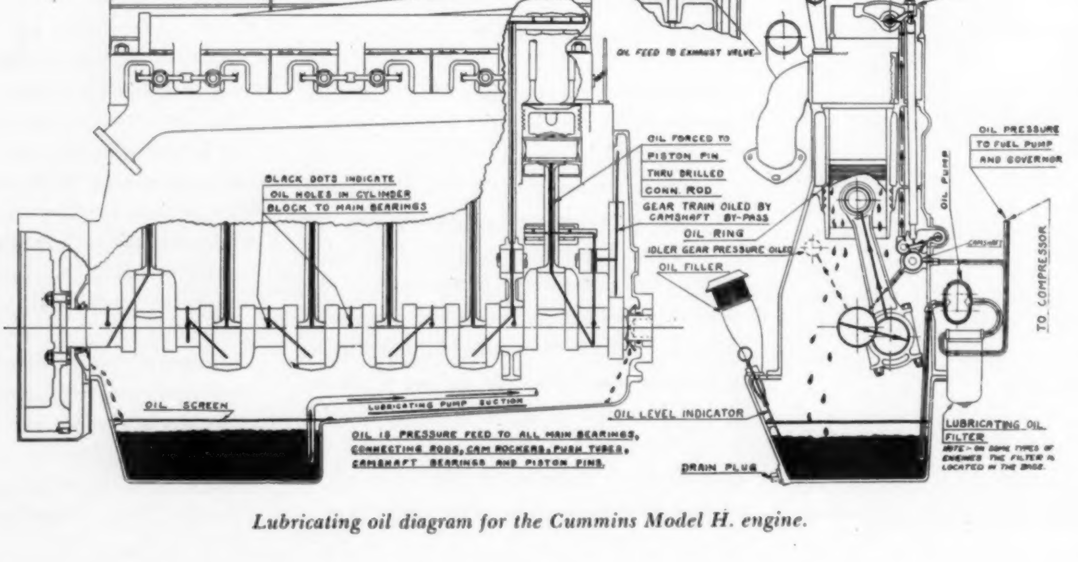
tor and governor all combined in one unit is on the front side of the engine. Note how this unit, the circulating water pump, the lubricating oil pump, and any others are all arranged to be driven by the gear train at the end of the engine. When the unit has an attached radiator for cooling, the fan drive is combined with that for the circulating water pump, and both are V belt driven from some shaft in the gear train.



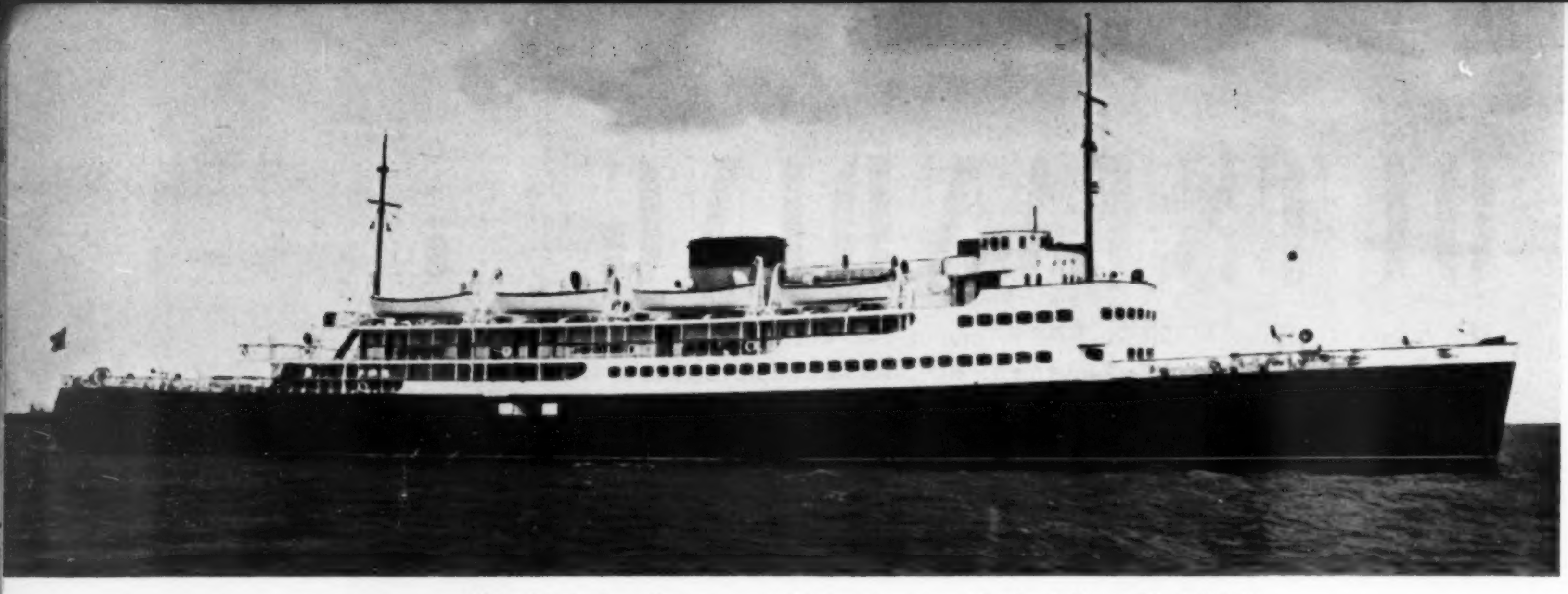

The lubricating oil system is quite clearly shown in the diagram. The sump is in the oil pan under the crankcase. The gear type pressure oil pump delivers through the cloth bag type filter to the distributing oil channels. All parts of the engine needing lubrication are cared for by the one system. One special feature is the placing of the spring loaded by-pass valve in the end of the camshaft. The hollow camshaft is used as the distributing channel along the engine, and the oil escaping from the by-pass valve sprays the gear train at the end of the engine. The thrust bearing for the camshaft is combined with this by-pass valve.

All of the smaller models are started by the usual electric motor with energy taken from batteries, and there is an attached generator for recharging the batteries. The largest cylinder size is fitted with air starting. There is a distributor driven from the end of the camshaft with pipes to the check valves in the cylinder heads.

The mere fact that these engines are used in such a wide variety of service applications implies even wider variations in the methods used to adapt the basic engine model designs to the individual installations. Most of the variations consist of accessories or equipment added to the engine, but on occasion it is necessary to make changes in the engine design itself. Just to mention a few of the items, there is the special base under the frame for use when bolting the engine to a concrete foundation or to steel skids for a portable installation. There is the built-in clutch for disconnecting the engine from the load. There is the attached air compressor for supplying compressed air for the brakes in truck installations. And there are such items as radiators and direct power take-off connections to generators and belt drives, and the marine reverse gears for marine engines.




*Lubricating oil diagram for the Cummins Model H. engine.*



*Motorship "Prins Albert," the world's fastest commercial Diesel ship. This 15,000 hp. vessel was recently placed in English Channel service by the Belgian State Railways.*

# LONDON LETTER NO. 25

*By* G. R. HUTCHINSON*

THE most interesting motorship to be completed this year is unquestionably the *Prins Albert,* which has recently been placed on the Dover-Ostend passenger service by the Belgian State Railways. When this enterprising company built the *Prince Baudouin* in 1934, this vessel represented a remarkable achievement. She was at that time the fastest motorship in the world, her Sulzer machinery developing 16,000 Bhp. on trial and giving her a mean speed over the West Hinder-Ruytingen measured mile course of 25.25 knots on displacement of 2,800 tons. This performance undoubtedly created a great impression in those circles where the cross-Channel vessel of any pretensions to speed is automatically regarded as a steamship. In point of fact, very few turbine-driven cross-Channel vessels can exceed the performance of the *Prince Baudouin,* while from the point of view of absence of standby losses, elimination of boiler uptakes and boiler rooms, she represents a distinct step forward and has clearly shown that Diesel machinery is perfectly suitable for developing the high speeds which are called for in the exacting cross-Channel services between this country and the Continent.

The new *Prins Albert,* apart from the utilization of the Flemish spelling of her name (or should we say *his* name?), is generally similar to the successful *Baudouin* and, like the earlier ship, has been built and engined by Soc. John Cockerill, of Hoboken, Belgium. Both ships are approximately the same dimensions, those of the *Prins Albert* being as follows: length overall, 371 ft.; length between perpendiculars, 360 ft.; breadth, 45 ft. 10 in.; depth to shelter deck, 24 ft. 9 in.; load displacement, 2,800 tons; corresponding draught, 11 ft. 3 in.; gross tonnage, about 3,300 tons; service speed, 22 knots.

In general layout the two vessels are broadly similar. The practice of having a separate auxiliary engine room has been followed in the new ship, this feature of the *Prince Baudouin* having also been followed in certain other successful cross-Channel motorships, notably those of the *Ulster Monarch* class, which run between Liverpool and Belfast. It is in the main machinery where the principal difference between the two vessels lies, although in both cases the designed aggregate output of the Sulzer-type main engines is 15,000 Bhp. with a maximum power of 17,000 Bhp. In the *Baudouin* previous Sulzer practice was followed inasmuch as separate motor-driven turbo-blowers supplied the scavenging air; this arrangement has, of course, been used in a considerable number of Sulzer marine Diesel engines of high and moderate power, although the tendency of the famous Swiss firm has in recent years been towards the use of reciprocating scavenging pumps driven off the engine itself. In the *Prins Albert* a complete departure from Sulzer tradition has been made in utilizing a separate scavenging pump for each cylinder. These pumps are of normal construction, each being driven from its proper crosshead by means of rocking levers and links. In this way the length of the twelve-cylinder main engines is kept as short as possible, while the elimination of the three large scavenging air blowers which are installed in the auxiliary engine room of the *Baudouin* has allowed a useful saving in total machinery space. Moreover, when it is recalled that each of these electric-motor-driven blowers is capable of producing something like 480 cubic metres of air per minute at 2,250 rpm., it will be appreciated that their elimination has enabled the Diesel-generator sets to be reduced in size to an appreciable extent. Furthermore, as electric heating is used in the earlier ship a considerable amount of current is required for this purpose. Actually the auxiliary Diesel-generator sets in the *Prins Albert* comprise three 200 kw. sets in addition to a small 10 kw. generator compressor set, as against four 480 kw. sets in the *Baudouin.* The net result of these interesting changes in engine room layout and machinery has meant a reduction in the length of both the main engine room and the auxiliary compartment; the length of the two engine rooms in the *Prins Albert* is 52 ft., as against 65 ft. in the first vessel. Furthermore, by moving the machinery forward a few frame spaces, better accommodation has been provided in the second-class saloon, which is aft of the main engine room.

**Editor of "Gas and Oil Power" and Managing Director of the Whitehall Technical Press, Ltd.*

Space does not allow of our giving a full description of the Sulzer type engines as installed in the *Prins Albert*, which were built at the Seraing works of Cockerill, in close collaboration with Sulzer Bros., of Winterthur. Notwithstanding the fact that these engines are of low overall height and low weight — actually they are appreciably under 50 lbs. per Bhp. — the crosshead principle has been adopted, as in the case of the *Baudouin's* machinery. Each engine has twelve cylinders, 22.9 in. in diameter by 33.1 in. stroke, with a normal rating of 8,500 Bhp. at 268 rpm.; the normal service output is 7,500 Bhp. per engine at 257 rpm. The piston speed, it will thus be seen, is in the comparatively high region of around 1,500 ft. per minute, although the mean indicated pressure at service rating is no more than 90 lbs. per sq. in.; the mechanical efficiency at full load should be rather better than 75 per cent, having regard to the fact that each engine drives its own forced lubrication pump and twelve scavenging pumps.

In order to achieve a low weight per Bhp. considerable use has been made of light-weight materials; thus the connecting rod is scientifically lightened and the four-shoe crosshead is likewise of light construction. The piston rod is bored throughout its entire length and is also relatively light in weight. A bi-metal piston is used with a forged steel ribless crown and a thin cast iron skirt. In the *Baudouin* sea-water cooling is used for the pistons, but in the new ship lubricating oil is the cooling medium — a real improvement in the writer's opinion.

The main engine controls are arranged at the forward ends at engine room floor level. Despite the space economy which has been effected in the engine rooms there is no impression that the auxiliaries have been crowded into the available space. Most of the engine room auxiliaries, such as cooling water, standby, lubricating oil and other pumps are motor driven, most of them, including the Sharples centrifugal purifiers, being of British manufacture. There is also a Cochran heating boiler installed in the auxiliary engine room.

The three auxiliary engines are eight-cylinder Sulzer four-stroke cycle locomotive type Diesels, the employment of which has proved successful in the *Baudouin*. Thus, the weight and space saving which their use has made possible has been thoroughly justified in practice. The whole of the machinery casings and bulkheads in the *Prins Albert* have been treated with a sound-deadening cork slab preparation, which undoubtedly has effected a considerable improvement in this direction. Furthermore, in the new ship double exhaust silencers have been provided and, despite this added resistance, the back pressure is no more than 4 in. of water.

Extensive trials were carried out with the new ship in the North Sea, when it was found that she maneuvered excellently and generally behaved in an exemplary fashion. A maximum speed of 25½ knots was reached, which is slightly better than that of the *Prince Baudouin*, and the reduction in noise and vibration in all parts of the accommodation was favorably commented upon. There seems little doubt that the all-round excellence of this new cross-Channel motorship will cause other owners to give serious consideration to Diesel propulsion when planning to replace some of the rather more obsolete steam tonnage which is now in operation on cross-Channel services between this country and the Continent.

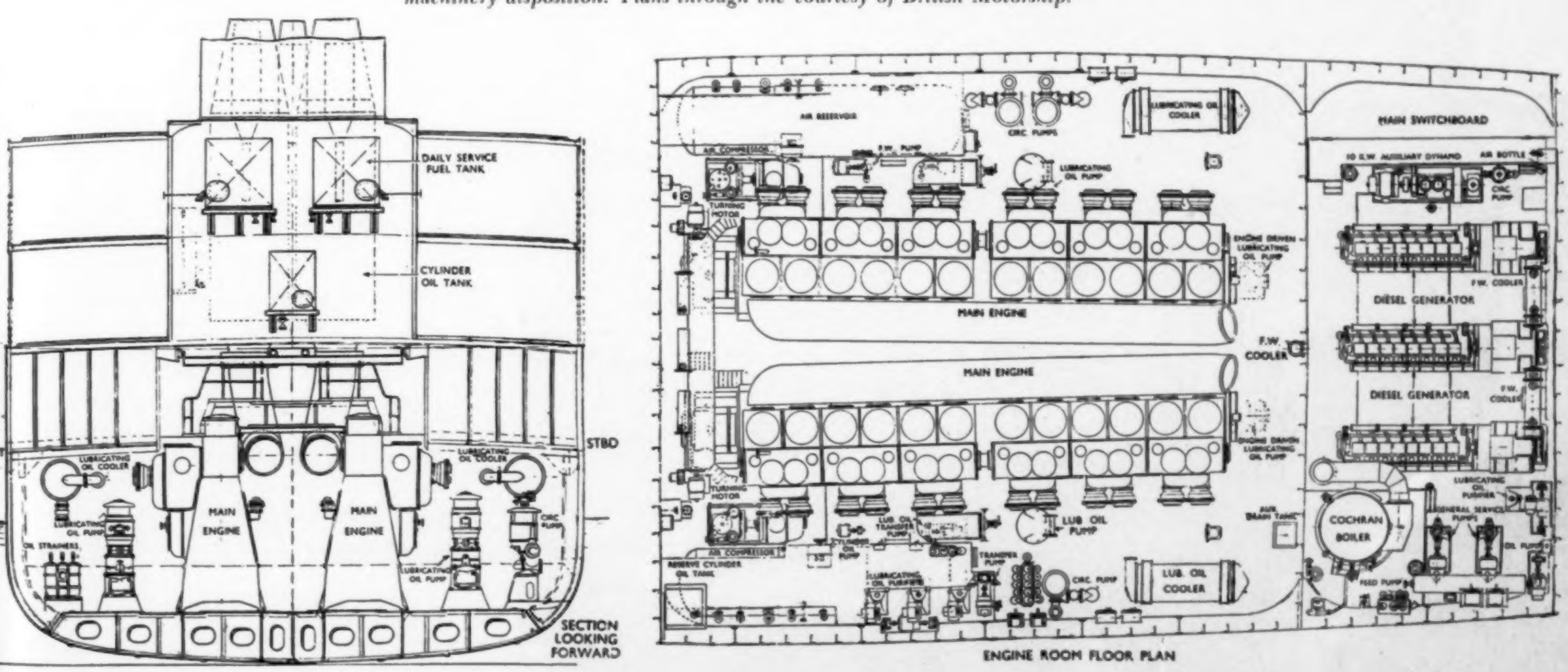
As is doubtless known to many readers of DIESEL PROGRESS, the British Broadcasting Corporation are extensive users of Diesel generated power. In a number of their stations oil-engine-generated electricity is used exclusively for power purposes, while in others, notably the Empire Broadcasting Station at Daventry, Diesel generated power provides standby current. Another example of this latter policy is to be seen in the new Northern Regional Station at Stagshaw, Northumberland, to the opening of which we were invited on October 19 last. The site is in a rural part of Northumberland some 16 miles west of Newcastle-on-Tyne. The mast aerial is 485 ft. high and the actual building is a modern-looking brick-built single-story structure of most pleasing outline.

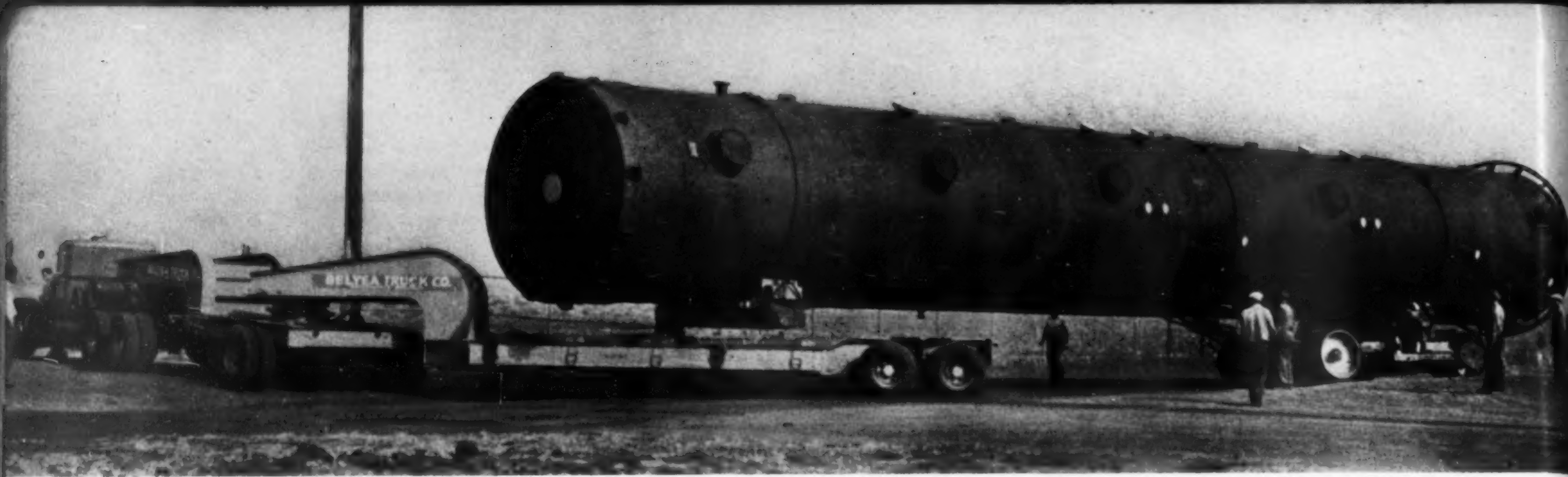
The main transmitter delivers 60 kw. to the aerial and power is obtained from the North Eastern Electric Supply Co. through a substation on the site. For emergency purposes in the case of mains failure the powerhouse includes a Diesel-driven alternator.

The engine is a six-cylinder Crossley four-stroke cycle airless-injection unit having a rating of 600 bhp. at 375 rpm. It is directly coupled to a three-phase 50-cycle 440/250-volt 400 kw. alternator, the output of which is controlled by the main switchboard in the powerhouse.

The alternator may be synchronised with the incoming supply so that a change-over can be made without interrupting the programme. There is also a battery equipment to provide emergency lighting and to operate the auxiliary equipment used in connection with the Diesel engine should the public supply fail entirely. Fuel for the Crossley engine is contained in two 40-ton fuel oil tanks, while cooling water for the engine as well as for domestic purposes is obtained from springs about half a mile from the station.

*Sectional and plan view of the "Prins Albert's" engine room showing machinery disposition. Plans through the courtesy of British Motorship.*





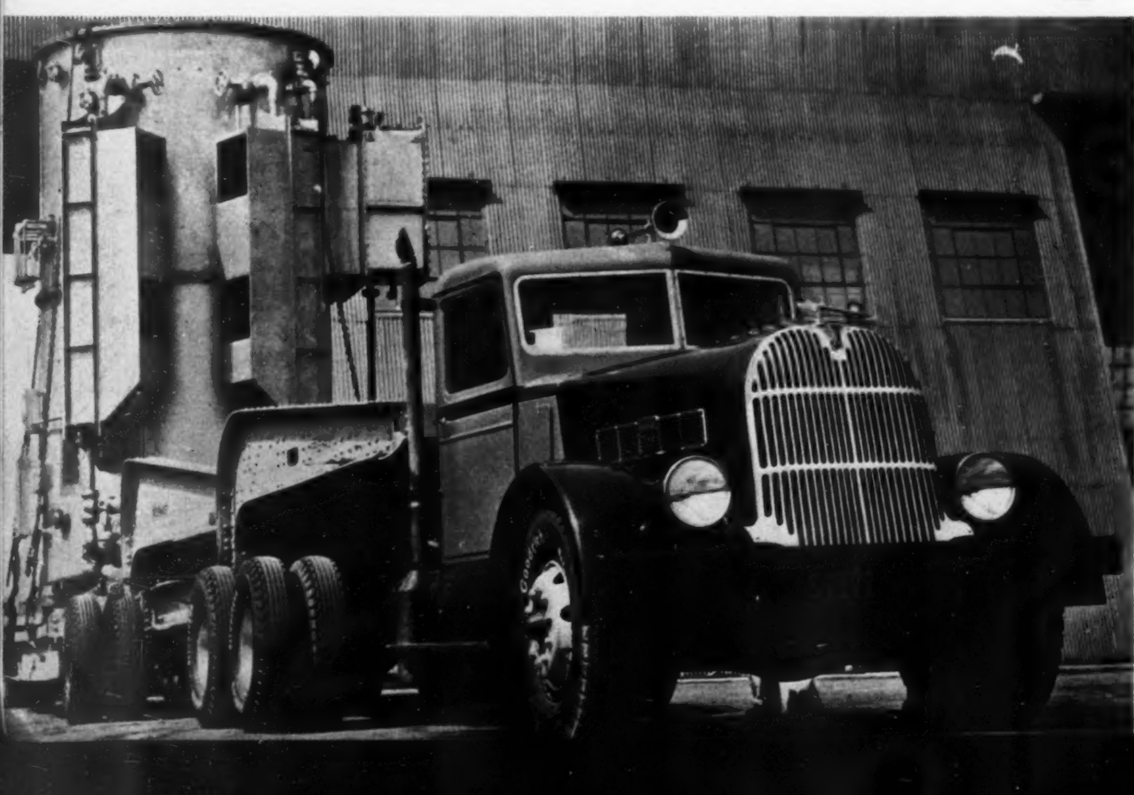

# 105 TON DIESEL TRUCK

*By* FLORENCE JOHNSON

THE largest load ever hauled by a single truck, and an equally difficult if less spectacular cargo problem are two recently completed by the Belyea Truck Company of Los Angeles. The largest load — a 105-ton bubble tower — was transported in one piece from the C. F. Braun Company plant at Alhambra, where it was built and tested for perfection of operation, to the General Petroleum Company's oil refinery at Torrence, California. The extreme length of the bubble tower, 91 feet, as well as the 105-ton weight presented a problem that taxed the capacity and ingenuity of Belyea, given the hauling contract. In previous shipments of this type, even where gross tonnage was very much lighter, it has been the custom to use two or more trucks pulling in tandem.

In this instance, however, the hauling equipment was a composite truck, assembled in Fageol Truck Company's plant in Oakland, using a Cummins 6-cylinder 125 hp. Diesel motor, Brown-Lipe model 70 main transmission and clutch, Brown-Lipe 703 auxiliary transmission and Sterling Motor Truck Company's dual-chain 4-wheel drive rear axle with triple differential. The Fruhauf Trailer Company of California designed and built a special 100-ton capacity low-bed semi-trailer and "jeep" (an auxiliary gooseneck front axle working between the main low-bed semi-trailer and the tractor). But the great length of the bubble tower required the use of another low-bed unit to act as a dolly to support the rear end of the enormous load. In obtaining permit to use the 25 miles of busy public highways and city streets between Alhambra to Torrence, they were given permission to make the journey between the hours of 2 a.m. and 7 a.m. The drive was rendered doubly difficult by a heavy fog, which made visibility dangerously low during the entire trip. The flexibility of this huge train was demonstrated when it was necessary to cross a surface railroad track where the roadbed had an elevation of 3 feet above the highway pavement — on a curve with a 60-foot radius. It was not necessary to slow down more than for right-of-way safety! So successful and unmarred by untoward incident was the transportation of this unprecentedly large load that two additional bubble towers were ordered and safely delivered with no more ado or concern over their shipping than is accorded the hauling of a bottle of milk.

No less masterful was the accomplishment of Belyea in transporting for the Los Angeles City Department of Water and Power seven gigantic transformers built as a result of the city's contracting for a volume of power from Boulder Dam. Each of the seven transformers weighed 95 tons. The delicate mechanisms made it imperative for them to be kept upright during moving, and as nearly level as possible. Hauled by the same Diesel dual chain 4-wheel drive tractor, using the jeep and low-bed trailer, these transformers, built at the District's plant at 1620 Main Street, were smoothly towed over crowded city streets to the Eastside Substation, a distance of five miles. Due to their extreme height (30 feet) the truck was routed over streets with high wire clearances. But a half mile of 6 per cent grade and a short 7 per cent grade was encountered near the Substation. It created a real test for the Cummins Diesel motor and the Sterling 4-wheel dual chain drive rear end with triple differential.



No greater proof of the efficiency and skill of the Belyea Truck Company can be shown than the ease with which these vast loads of three 105-ton bubble towers and seven 95-ton transformers were speedily transported on single trucks without mishap or annoyance to anyone.

## HERCULES

**A**S a further step in its program to make available a complete line of high-speed Diesel engines, paralleling in performance and installation dimensions Hercules gasoline engines of similar displacement, Hercules Motors Corporation has announced the series "DOO" four-cylinder Diesels.

Of neat, compact design, the new "DOO" series has been developed particularly for use in commercial vehicles of smaller and more popular sizes as well as for a wide variety of industrial, agricultural, oil field and marine applications. Three models of the new series have been produced. The smallest, the "DOOB" has a bore of 3¾" and a stroke of 4½" with the total piston displacement of 198.8 cu. in The "DOOC" has a bore of 4" and a 4½" stroke with 226.2 cu. in. displacement and the "DOOD" has a 4¼" bore and 4½" stroke with a 255 cu. in. displacement.

The "DOOB" is rated at 62 hp. and the "DOOC" at 70 hp. at an engine speed of 2600 rpm. At 1600 rpm. the "DOOD" develops 56.5 hp.

A rigid crankshaft of ample proportions, with bearing surfaces electrically hardened by the Tocco process, is supported by five bearings in a crankcase which is cast integral with the cylinders. The crankcase also supports the four bearing camshaft. Aluminum alloy pistons are used for maximum heat conductively and lightness of reciprocating parts. Connecting rods are of heat treated nickel chrome molybdenum steel, rifle drilled, providing pressure lubrication to the full floating piston pins.

The series of Hercules "DOO" Diesels is available in power unit form, either fully enclosed or in the open type of assembly, such as is used for pump and generator drives and industrial applications generally. The series promises to meet an increasing demand for a small four cylinder high speed heavy duty type Diesel thus making available Diesal economy for new and larger fields.

## MACHINING ALUMINUM

**A** COMPLETELY revised edition of the booklet, *Machining Aluminum,* is now available to the readers of DIESEL PROGRESS through written request to the Aluminum Company of America, Pittsburgh, Pennsylvania. Everyone engaged in the design, machining or production of aluminum and aluminum alloy products will find interesting and up-to-the-minute information in this latest release.

## S.A.E. NEWS

**I**N an effort to stabilize the supply of No. 1 Diesel tractor fuel available over different parts of the country so that the user can be assured of a standard, uniform fuel regardless of location, a Subdivision of the Tractor and Equipment Division of the SAE Standards Committee has been appointed to draft a simple definition of this fuel for adoption as an SAE standard.

In two sessions of vital interest to Diesel men, the SAE Diesel Engine Activity has planned five papers covering a broad range of Diesel activity for the SAE 1938 Annual Meeting, scheduled for Jan. 10 to 14, in Detroit. One of the two aircraft Diesel papers on the tentative progress is the "Status of the Diesel as a High-Output Engine for Aircraft," by E. G. Whitney of the National Advisory Committee for Aeronautics. Authors of the two papers on Diesel supercharging planned for the meeting are Russell Pyles of the Chicago Pneumatic Tool Co. and Harte Cooke of the American Locomotive Co. "The C.F.R. Automotive Diesel Fuel Progress Report," by T. B. Rendel, chairman, will complete the program.

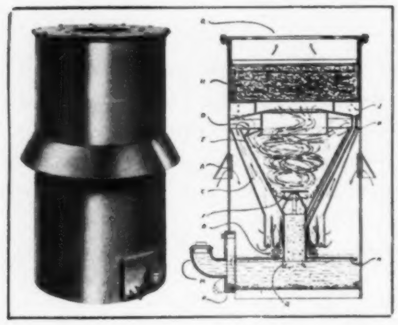
Containing an up-to-the-minute review of Diesel engines for trucks and a frank discussion of the problems raised by Diesel powered trucks in tunnel traffic two papers at the SAE Regional Transportation and Maintenance Meeting, Newark, N. J., Nov. 9 and 10, were indicative of the growing interest in the Diesel in the truck-transportation field. Held simultaneously with the National Motor-Truck Show the Meeting dealt entirely with trucks, their maintenance, design and selection.

"It appears that there will be a slow but steady increase in usage of the Diesel engine in trucks," forecasted Joseph A. Anglada, concluding his discussion of Diesel design trends in his paper: "Development and Trend in Truck Design," at the Newark SAE T & M Meeting. To explain the rapid progress made recently in the development of the high-speed automotive Diesel, Mr. Anglada quoted from an article by Harry R. Ricardo: "A new school of engineers with no respect for inherited tradition, took possession of the heavy oil engine, determined to make it dance to a livelier tune, and even to race the gasoline engine on the public highways."

SAE Past President Charles F. Kettering was the chief speaker at a luncheon staged during New York Auto Show Week by General Motors Corp. to celebrate the 40th anniversary of the invention of the Diesel engine.

## NEW AIR FILTER

THE American Air Filter Company announces the "Cycoil" oil bath air cleaner designed especially for the protection of air compressors, oil and gas engines. The "Cycoil" employs a new principle of air cleaning, applied for the first time in a commercial unit.



*Exterior view and cutaway section of the American Air Filter Company's new "Cycoil" oil bath unit.*

Referring to drawing, air enters at "A" and passes downward. In sweeping across the plate "N", it picks up an oil spray which is carried upward through passage "C". At point "D", the oil and air mixture passes downward through vanes which impart a whirling motion, and the major portion of entrained oil together with most of the dust is thrown to the walls of the inverted cone "E" by centrifugal force. The pre-cleaned air then passes upward through a crimped wire filter cell where the last traces of oil and dust are removed, and the dust-laden oil passes back into oil reservoir where the dust settles out before oil is recirculated.

The advantages claimed for the "Cycoil" air cleaner are: Extremely high cleaning efficiency even under heavy dust concentration. Elimination of all linty dust in pre-cleaner. Extra large dust-holding capacity to take care of sand storms, etc. Easy and simple maintenance.

"Cycoil" air cleaners are now available in sizes suitable for handling 250 cfm. to 2,000 cfm.

## C. B. MURPHY

THE Power Engineering & Equipment Company, P.O. Box 3095, Dilworth Station, Charlotte, N. C., has been formed to install complete power plants. This company represents the Superior Diesels in the Carolinas. C. B. Murphy, so well and favorably known throughout the Diesel industry as "Pat" Murphy, is one of the moving spirits behind this enterprise.

## MODERN DIESEL LOGGING

. . . . *Continued from page 40* . . . .

push back up into the hills, farther and farther from the mills and from tidewater, increasingly important becomes this transportation factor. In this steep, rugged rocky country it would cost a fortune to build a railroad to hold a suitable grade. Trucks, however, fear not the varying grade; the over-one-hump-and-down-into-the-other-one method of building a cheaper road. Of course, adverse grade (against the load) is not to be desired, but we are shooting for CHEAP LOGS, and cheap logs we get by using the modern Diesel-powered motor truck. Again we have the regular exhibition of superior performance that has come to be expected of a Diesel-powered unit of any sort – get it because of the very characteristics of the Diesel engine itself.

The truck does not falter on steep grades – she keeps coming when Diesel-powered away up the grade instead of shifting down near the bottom. She "hangs" in the gear, maintaining a faster average speed on ascending grades than any gasoline engine has been able to make.

In a session of the recent Pacific Logging Congress, held at Seaside, Oregon, during late September, an outstanding authority on truck logging presented a paper outlining the advantages gained and the economies effected by using large motor trucks powered with Diesel engines. Formerly they had used smaller trucks, and then larger trucks with gas engines, but the results obtained with the Diesel-powered trucks were so outstanding and his arguments for them were so convicing that it seems certain that no one contemplating the opening of a new logging operation, or in determining a method of transportation, could think other than about Diesel-powered trucks.

The Logging Congress mentioned above at Seaside would have been interesting to anyone awake to the possibilities of the Diesel engine.

Not a piece of steam equipment was exhibited, hardly a word was heard about it. Diesel units were everywhere – tractors, shovels, loaders, yarders, generating sets for camp lighting and power, motor trucks and many power units. It was noticeable that every donkey of any size at all, or with an engine over 400 cubic inches displacement, was powered by Diesel. Motion pictures shown during some of the business sessions showed three or four different reels of motor trucks all using Diesels. It was noticeable that all the spectacular operations – the ones who are doing the impossible – are using Diesels. Surely there must be something to it!

## "ALNOR" PYROMETER CONTROLLER

The "Alnor" Pyrometer Controller is offered for those who desire automatically to control temperatures of heat treating furnaces, melting pots or other heating devices at a definite predetermined point.

The principal of operation is electronic similar to a radio circuit. The pointer of the indicating pyrometer carries a small vane. An adjustable target is provided which carries two condensor plates or vanes. These vanes are the capacitive element of a tuned circuit.

Except at the point when the temperature indicating pointer and the target coincide the circuit is unchanged. When the temperature pointer with its vane approaches the temperature setting, the vanes of the pointer and target interweave and produce a circuit change which in turn operates a relay. The heating current if electric is shut off or in case of the fuel fired operation, the fuel valve is closed partially or completely depending on the type of valve used.

There is neither motor nor depressor bar used in the Alnor Controller nor is there any direct contact between the vanes. The temperature indicating pointer is free to give continuous indication and control.

For fuel fired applications, a suitable valve must be used which can be either of the solinoid or motorized type as desired or necessary for the requirement.

The indicator movement is the same as that which has made "Alnor" so universally known for over 15 years for their accuracy and dependability. It has unusually high torque for its high internal resistance. It is double pivoted with two highest quality jewel bearings. Its 6 inch mirrored scale provides ease of reading. An automatic cold end compensator of the spiral type is furnished as standard equipment.

## SHARPLES EXHIBITS

DURING the week of December 6 to 11, the Sharples Specialty Company will maintain a very interesting exhibit (Booth No. 59) at the sixteenth annual Exposition of Chemical Industries. The following Sharples equipment may be inspected there at that time:

The Rotojector, which is a high speed centrifugal, so designed that it is self-cleaning, requiring only about ten seconds to clean the bowl while running;

A 15,000 rpm. commercial Super Centrifuge, having bronze frame and Monel bowl and contact parts;

The new proportionometer and mixer as developed for the continuous treating equipment for caustic refining of vegetable oil and for acid treating of mineral oil;

A 50,000 rpm. turbine driven Laboratory Super Centrifuge, developing 62,000 times the force of gravity, having bowl and contact parts of Monel construction;

Last and most important, the new Sharples Ultra Centrifuge will be operated in the booth, at a speed of 80,000 rpm., developing 250,000 times the force of gravity, in a vacuum of $\frac{2}{10}$ths micron pressure, special photographic equipment being used to take photographs of the action inside the bowl while running.

## SUPPLY LIMITED

WE now have but thirteen copies of the *Standard Practices* left on hand. This book has enjoyed a remarkable sale. It was published by the Diesel Engine Manufacturers Association late last year and has become the bible of the consulting engineer, Diesel salesman and prospective Diesel engine user.

And logically so, it contains a mass of vital information pertaining to standard performances, equipment and definitions. The cost of Diesel power. The selection of engine sizes for a given load. Power plant buildings. Engine construction. Governors and speed regulation. Erection data. Fuel oil storage and handling. Lube oil systems. Cooling water systems, etc., etc. Everything you need to know on Standard Practices—and the price of this unique book is but TWO DOLLARS. Subject to the supply now on hand we offer our readers this book—and heartily recommend it to them.

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DIESEL PROGRESS, 2 W. 45th St., New York.

Enclosed find $2.00, send me a copy of *Standard Practices* postpaid.

Name ....................................

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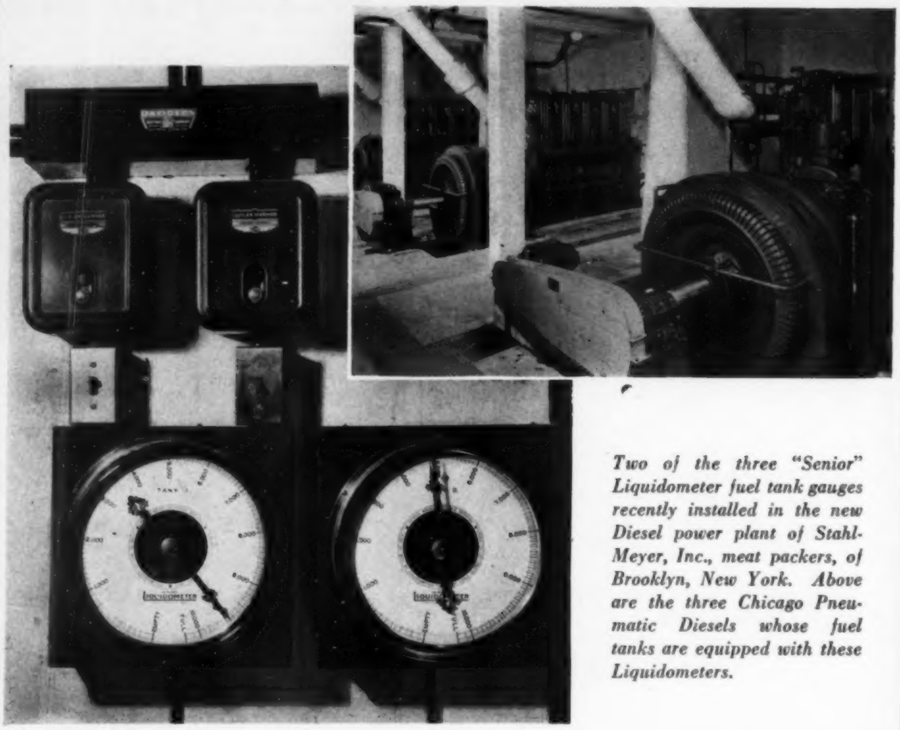
# Nothing but the **BEST**



*Two of the three "Senior" Liquidometer fuel tank gauges recently installed in the new Diesel power plant of Stahl-Meyer, Inc., meat packers, of Brooklyn, New York. Above are the three Chicago Pneumatic Diesels whose fuel tanks are equipped with these Liquidometers.*

**A COMPANY producing food for public consumption must necessarily demand the best of everything. The selection of Liquidometer tank gauges in this new Diesel plant of Stahl-Meyer, Inc., proves them equally critical of equipment quality as they are of food quality.**

**The easily read dials of these instruments enable engineers to check quickly and accurately oil deliveries, consumption and amount on hand. No Diesel plant is complete without Liquidometer Remote Reading fuel storage tank gauges. Specify Liquidometer or Levelometer. Models available for tanks of any capacity.**

***Write for data.***

## The **LIQUIDOMETER** Corp.

**36-24 SKILLMAN AVENUE, LONG ISLAND CITY, N. Y.**

## 66% SAVINGS

- **The Avalon Dairy, Middletown, Ohio, reduced Power cost 66% when they installed an 80 HP Buckeye Diesel Generator Set replacing Purchased Power.**
- **Buckeye Diesels are strictly stationary medium speed engines. Sizes range from 40 HP and up to 600 HP in single units.**
- **Let us give you more details on these economical engines for your plant.**

***Write for catalog and bulletins on your letterhead.***

**The Buckeye Machine Co.**
Engine Builders Since 1908
**Lima, Ohio**

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**FACTORY REPRESENTATIVE** — "After completing my course I was employed as factory representative."—C.L.

"I am on my fifth month as a fitter in the parts and assembly department."—G.R.C. — **FITTER**

"I am installing and operating their ten unit plant." — C. G.L. — **OPERATOR**

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## ELCO CRUISERS

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**DIESEL GENERATOR BARGAINS**

Very latest Cummins 6-cyl. 85 hp. dir. con. 45 kw. 3/60/110-220, 4-wire gen. dir. con. exciter on com. base; complete with panel board, all instruments and Terrill vt. reg. Used but 2 mo. perfect condition. Price \$3,750. Also new 20 kw. Cat. Diesel set at discount.

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DIESEL PROGRESS

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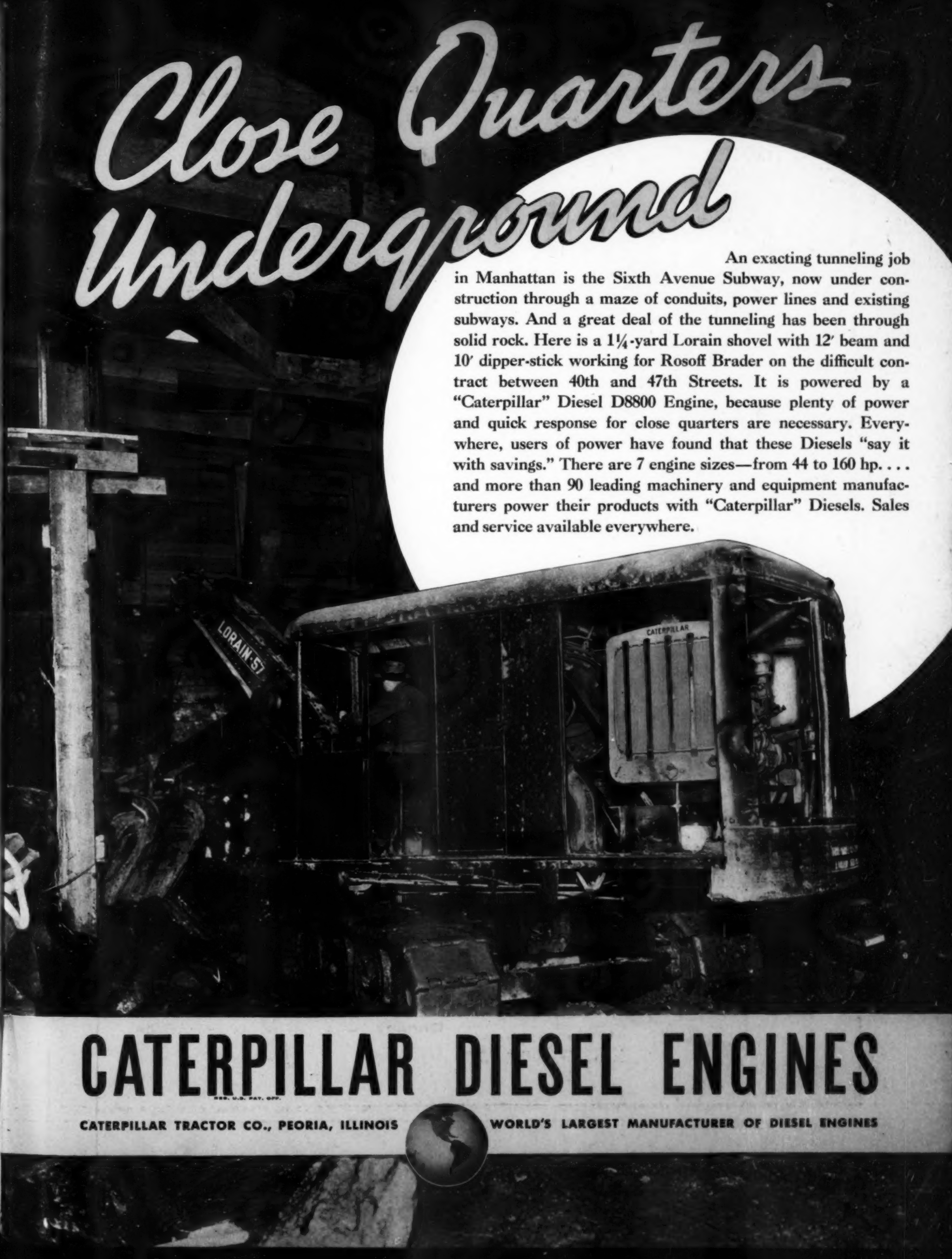
Close Quarters Underground
An exacting tunneling job in Manhattan is the Sixth Avenue Subway, now under construction through a maze of conduits, power lines and existing subways. And a great deal of the tunneling has been through solid rock. Here is a 1¼-yard Lorain shovel with 12′ beam and 10′ dipper-stick working for Rosoff Brader on the difficult contract between 40th and 47th Streets. It is powered by a "Caterpillar" Diesel D8800 Engine, because plenty of power and quick response for close quarters are necessary. Everywhere, users of power have found that these Diesels "say it with savings." There are 7 engine sizes—from 44 to 160 hp. . . . and more than 90 leading machinery and equipment manufacturers power their products with "Caterpillar" Diesels. Sales and service available everywhere.
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